ECLIPSE
ENGINEERS, PLLC

June 30, 2017

Ms. Lori Dials
Environmental Scientist
Water Infrastructure Branch
Kentucky Division of Water
300 Sower Boulevard, 3rd Floor
Frankfort, Kentucky 40601

Re: Wastewater System Facilities Plan
City of Marion
Marion, Kentucky

Ms. Dials:

On behalf of the City of Marion, Eclipse Engineers is submitting for your review and approval the above referenced Facilities Plan (FP). This FP has been mandated by an Agreed Order with the Department of Enforcement. The FP provides background information, future conditions, and describes a new collection system rehabilitation project and a new WWTP project.

Attached are the following:

- One (1) copy of the Facilities Plan

A digital copy of the Facilities Plan will be emailed to you as well. If you need any additional information or have any comments do not hesitate to call me at (606) 451-0959 or (859) 433-9585.

Sincerely,
Eclipse Engineers, PLLC

Alan R. Robinson, P.E.
President

113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959
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FACILITIES PLAN

JUNE 30, 2017

CITY OF MARION

MARION, KENTUCKY

Prepared by:

ECLIPSE ENGINEERS, PLLC

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Facilities Plan

City of Marion

Marion, Kentucky

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Abbreviations/Acronyms

ADF	Average Daily Flow
BOD_5	Five-day Biochemical Oxygen Demand
CIPP	Cast-in-place-pipe
DIP	Ductile Iron Pipe
DO	Dissolved Oxygen
DOE	Division of Enforcement
DOW	Division of Water
FEMA	Federal Emergency Management Agency
ft	Feet
FM	Force Main
gpcd	Gallons per Capita per Day
GPD	Gallons per Day
GPD/ft^2	Gallons per Day per Square Foot
GPD/inch-mile	Gallons per Day per Inch-Diameter Mile
GPD/LF	Gallons per Day per Lineal Foot
GPM	Gallons per Minute
HP	Horsepower
HRT	Hydraulic Retention Time
I/I	Infiltration/Inflow
KIA	Kentucky Infrastructure Authority
KPDES	Kentucky Pollutant Discharge Elimination System
lb	Pound
lbs/day	Pounds per Day
$lbs/day/ft^2$	Pounds per Day per Square Foot
MG	Million Gallons
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
NH_3-N	Ammonia Nitrogen
OH&P	Overhead and Profit
O,M&R	Operation, Maintenance and Replacement
O&M	Operation and Maintenance
P	Phosphorus
PE	Population Equivalent
pH	Measure of Acidity/Alkalinity
PIPC	Personal Income per Capita
PS	Pump Station
PVC	Polyvinyl Chloride
RAS	Return Activated Sludge
RD	Rural Development
RI I/I	Rain-Induced Infiltration/Inflow
RPM	Revolutions per Minute
SRT	Solids Retention Time
SWD	Side Water Depth
TDH	Total Dynamic Head
TSS	Total Suspended Solids
WAS	Waste Activated Sludge
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Section I – Regional Facility Plan Summary

A. Objective

The objective of the Facilities Plan for the City of Marion (City) is to achieve the following:

- Develop a cost-effective, environmentally sound strategy for construction of wastewater collection and treatment facilities to accommodate the current city's needs and projected growth.

- Minimize the financial impact on wastewater system customers.

- Comply with all current and pending water quality regulations including satisfying all requirements of the Division of Enforcement (DOE) Agreed Order (AO).

The scope of the Facilities Plan includes: a discussion of the project background, a review of existing environmental conditions, an evaluation of existing wastewater system facilities, projection of future population and wastewater flows, development and evaluation of wastewater system alternatives, selection of a cost-effective improvements plan, and development of an implementation strategy. This Facilities Plan is based on a planning period of 2020-2040. No other major sanitary sewer projects are currently planned for this planning period other than this collection system rehabilitation and new WWTP.

B. Project Background

The project background and planning area environment were reviewed to gain an understanding of factors that could impact the development of wastewater system alternatives. Some factors considered include current population, socio-economic conditions, land use, hydrology, land features, floodplains, and biotic communities. Population trends indicate little to no growth for the City of Marion and Crittenden County. The City of Marion presently accounts for approximately 33 percent of the county's population.

C. Existing Wastewater System Facilities

Most of the City of Marion and surrounding area are served by a conventional gravity sanitary sewer collection system and wastewater treatment plant owned and operated by the city. The City maintains approximately 131,900 linear feet of gravity sewer lines, 14,000 linear feet of force main, 4 non-clog pump stations, 2 duplex grinder pump stations, and 23 simplex pump stations. The city is committed to an ongoing program of infiltration/inflow (I/I) reduction to

reduce the magnitude of weather-induced peak flows at the WWTP, and the frequency of occasional overflows in the collection system.

The existing Marion Wastewater Treatment Plant (WWTP) is located adjacent to Rush Creek. The plant was originally constructed in 1972 and expanded in 1988. The influent pump station was expanded in 2010. The WWTP has a rated capacity of 0.66 million gallons per day (MGD). Although permit requirements are generally being met, the plant is vastly undersized and hydraulically overloaded. Equipment is aged and deteriorating. In the last 5 years, the City has documented 60 sanitary sewer overflows (SSOs) at the WWTP or in the adjacent trunk sewer. Due to these violations, the city has entered into an Agreed Order with the DOE. The DOE has accepted the City's Corrective Action Plan and all work must completed by July 2021.

Based on a review of operating data and on-site observations, the Marion WWTP appears to be poorly maintained. However, much of the equipment is well past the end of its useful life and has increasingly high maintenance requirements. This situation will worsen unless major investments are made to replace equipment. Also, all of the process facilities are undersized for the amount of wet weather flow that enters the plant, and cannot reliably meet present or future needs. These limitations have resulted in the permit violations and the Agreed Order noted above. Finally, treatment requirements that are beyond the capability of the existing WWTP are anticipated in the next permit revision and will required a complete process replacement.

D. Future Conditions

Based on information from previous planning studies and the Kentucky State Data Center at the University of Louisville, population projections were made for the City of Marion and Crittenden County. It is estimated that by year 2040, the planning area service population will likely decrease. The 20-year projected design flow for the WWTP is 1.5 MGD, with a peak hourly flow rate of 6.0 MDG.

E. Analysis of Alternatives

The analysis of alternatives for the collection system and WWTP is summarized below.

Collection System

A limited analysis of a conventional gravity sewer system versus low pressure sewer was conducted. It was determined that the conventional gravity sewer system would be less costly than low pressure sewer. Due to lower cost, operator familiarity, and in-kind replacement with conventional gravity sewers, this type of collection system is recommended for rehabilitation and of the selected areas of the Marion sewer system.

The wastewater collection system improvements will be constructed just before the WWTP in the 0-2 year period. The opinion of probable construction cost for these improvements is $2.1 million. Engineering and development costs will be $245,000 for a total of $2.3 million.

WWTP Alternatives

Beginning in the same 0-2 year planning period, a new WWTP will be constructed. The following alternatives were developed for the construction of a new treatment plant with a capacity of 1.5 MGD, and a peak of 6.0 MGD:

1. Construct a new Sequencing Batch Reactor (SBR) System at the new WWTP site.

2. Construct a new Oxidation Ditch (OD) System at the new WWTP site.

3. Construct a new Continuously Sequencing Reactor (CSR) System at the new WWTP site.

Based on the present worth comparison and effectiveness analysis, the third alternative was selected, which will include the following:

- Influent pump station
- Headworks consisting of flow measurement, mechanical screen, and splitter box
- Two CSR's
- Chemical feed and blower building
- Three circular secondary clarifiers with upstream splitter box
- RAS/WAS pump station
- Ultraviolet disinfection system with PAA pretreatment
- Cascade aeration ladder
- Gravity sludge thickener and sludge pump station
- Rotary fan press / maintenance building for sludge dewatering

The opinion of probable construction cost for the WWTP is $9.9 million. Engineering and development costs will be $1.1 million for a total of $11 million.

F. Project Implementation

These projects have secure funding in place with a KIA Fund A Clean Water Loan. A KIA Planning and Design Loan has already been implemented. Other funds that will likely be included in the project are Community Development Block Grant (CDBG) and Delta Regional

Authority (DRA). Important implementation steps recommended to cost-effectively proceed with the wastewater system improvements include:

- Public hearing
- Review and approval of Facilities Plan by DOW
- Continue CDBG and load funding applications
- Preliminary and final design
- DOW review and approval of construction documents
- Advertise and receive competitive bids
- Construct project
- Complete facility start-up

Section 2 – Statement of Purpose of Need

The purpose of need for this Facilities Plan is based from the following:

- To address water quality or public health concerns, inadequate system or system components related to wastewater, and to comply with existing levels of effluent quality.
- Comply with all current and pending water quality regulations including satisfying all requirements of the Division of Enforcement (DOE) Agreed Order (AO).
- To create a plan to address the extensive collection system inflow.
- To construct a new WWTP to treat peak hydraulic flow as inflow is decreased moving forward.

Section 3 – Physical Characteristics of the Planning Area

The following items are included in this Facilities Plan which detail physical characteristics of the Planning Area:

- A 24x36 map of the planning area illustrating the existing service area, planning area, watershed boundaries including new sewersheds delineated for the system, the City of Marion (service area). This map is included in *Appendix H* and a half-size map may be found in this Section.

- A 24x36 map illustrating the location of the wastewater treatment plant (WWTP), the proposed WWTP site, collection lines, pump stations, and force mains, drinking water intake points, and water treatment plant (WTP). The City does not have a Source Water Area Protection Plan (SWAPP) or Wellhead Protection Areas (WPA's). Lake George (primary supply) has a watershed of approximately 729 acres and City Lake (backup supply) has a watershed of approximately 2,950 aces. These watersheds are almost entirely undeveloped or agricultural in use. Every resident of Marion has access to public drinking water. This map is included in *Appendix J* and a half-size map may be found in this Section.

- A 24x36 USGS topographic map showing the City of Marion and the service area may be found in *Appendix S*. A half-size map may be found in this Section.

- Current 100-year FEMA floodplain maps may be found in *Appendix D*.

- A local planning and zoning map may be found in the City of Marion Comprehensive Plan in *Appendix T*.

The planning area for this 2020-2040 period will not change from the existing service area.

Section 4 – Socioeconomic Characteristics of the Planning Area

A. Purpose

The purpose of this chapter is to:

- Provide a description of the planning area.
- Identify the local governmental entities involved in the Facilities Plan.
- Discuss population trends and present socio-economic conditions.

B. Planning Area

The City of Marion is located in western Kentucky. Marion is located in the geographic center of Crittenden County, and is the largest city in the county.

The Planning area identified by this Facilities Plan, includes the entire City of Marion and adjacent portions of the county. This planning area identifies a region which should be served by the city's wastewater treatment plant (WWTP). It does not identify boundaries of legal entities.

C. Entities Involved

The City of Marion is the sole entity involved in the Facilities Plan process. Upon completion of the Facilities Plan, copies of the report will be provided to the city. Subsequently, it is expected that the city will pass resolutions approving the proposed planning area boundary and concurring with the recommendations in the report. The resolutions will be included in *Appendix A.* The Facilities Plan will be submitted to the Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water (DOW), for their review and approval. The public meeting documentation, once available, will be inserted in *Appendices B and C.*

D. Population

Crittenden County and Marion experienced moderate population growth from 1970 to 1980. However, between 1980 and 2010, populations of both the county and the city became stagnant in growth, showing slight fluctuations in population growth and decreases throughout the 30 year span.

Population projections contained in Marion's Comprehensive Plan (City of Marion Comprehensive Plan Update and Addendum, Then Pennyrile Area Development District, 2006) and projections made by the Kentucky State Data Center, and the US Census Bureau, indicate that both the city and the county will continue to experience insignificant growth through year 2040.

A small population of unsewered area is located in the service area. These areas are discussed in Chapter 6. The City does not intend to add these areas during this planning period.

Table 4-1
Population Trends

Year	Population		Marion's Population as a Percent of Crittenden County's Population
	Marion[2,3]	Crittenden County[1]	
1970	3,008	8,493	35.4%
1980	3,392	9,207	36.8%
1990	3,320	9,196	36.1%
2000	3,196	9,384	34.1%
2010	3,002	9,315	32.2%
2020	3,039	9,103	33.4%
2030	--	8,828	--
2040	--	8,545	--

Notes: [1]Source: Projections of Population and Households 2015 – 2040, State of Kentucky, Kentucky Counties, and Area Development Districts, 2016; Kentucky State Data Center, University of Louisville, www.ksdc.louisville.edu
[2]Sources: City of Marion Comprehensive Plan Update and Addendum, The Pennyrile Area Development District, 2006
[3]Sources: US Census Bureau, www.census.gov

E. Socio-Economic Conditions

Employment and Economic Development

Since 2000, Crittenden County employment has been dominated by manufacturing, trade, transportation, utilities, and services sectors. The trade, transportation, utilities and services sectors accounted for 45 percent of all jobs in 2000, and the manufacturing sector accounted for 20 percent of all employment in 2000. Mining and information, which have traditionally provided the highest average wage of the employment sectors, accounted for less than 5 percent of all employment in Crittenden County in 2000.

In the period 2000-2013, employment in all sectors decreased by a total of 581 jobs, from 3,013 jobs in 2000 to 2,432 jobs in 2013 (totals excludes education, health, and social services sectors). During that same time frame, jobs in the services sector increased from 103 to 474,

an increase 371 jobs. However, jobs in the manufacturing, trade, transportation, and utilities sector decreased by 373 jobs, from 1,444 in 2000 to 1,071 in 2013.

The importance of agriculture, mining, and construction to the economic base has declined steadily during that timeframe. For example, in 2000 agriculture, mining, and construction accounted for 817 jobs of all employment, yet in 2013, agriculture, mining, and construction accounted for only 469 jobs of all employment in Crittenden County.

Table 2-2 summarizes the number of jobs and average weekly salaries for various employment categories in 2013.

Table 4-2
Crittenden County Employment and Wages by Place of Work, 2013[1,2]

Category	Number of Jobs	Average Weekly Wage (Crittenden Co.)	Average Weekly Wage (Kentucky)
Agriculture, Forestry, Fishing and Hunting	179	$426	$568
Mining	34	$944	$1,888
Construction	256	$705	$1,019
Manufacturing	574	$793	$1,176
Trade, Transportation, and Utilities	497	$409	$817
Information	17	$887	$1,616
Financial Activities	96	$636	$1,549
Services	474	$576	$857
Public Administration	107	$412	$1,097
Other	198	$235	$987
All Industries	**2,432**	**$566**	**$957**

Source: [1]U.S. Department of Labor, Bureau of Labor Statistics
[2]Source: City of Marion Comprehensive Plan Update and Addendum. The Pennyrile Area Development District, 2006

The major manufacturing firms in the county are listed in Table 2-3. All of the firms are located with the planning area. No new industries are anticipated in the planning period 2020-2040.

Table 4-3
Major Manufacturing Firms and Employment in the City of Marion – 2006[1]

Firm	Employment
CeraTech, Inc.	15
Rogers Group, Inc.	25
Ohio River Concrete Corp.	6

Par 4 Assemblies, Inc.	25
Par 4 Plastic, Inc.	230
Turner & Conyer Lumber Co.	37
Safetran, Inc.	50
Martin's Tire Recycling	58
Siemens Rail Automation	240

Note: [1]Source: City of Marion Comprehensive Plan Update and Addendum. The Pennyrile Area Development District, 2006

Income Levels

According to the U.S. Department of Commerce and Bureau of the Census, Crittenden County had a personal income per capita (PIPC) of $34,488 in 2014. From information provided in Table 2-2, the manufacturing sector provided the greatest source of personal income, followed by trade transportation, and utilities; services; and government.

Median household income for Crittenden County residents was $33,356 in 2014, which is roughly 92 percent of the state median. Approximately 22 percent of Crittenden County's non-institutionalized residents lived below federally defined poverty levels in 2014.

Section 5 – Existing Environment in the Planning Area

A. Purpose

The purpose of this chapter is to:

- Describe existing land use.
- Discuss the area's hydrology, land features and floodplains.
- Address climate, precipitation, air quality, and biotic communities.
- Consider the possibility of archaeological sites within the planning area.
- Present water quality objectives.

B. Land Use

The land use pattern of an area is one of the major factors in determining potential water quality problems. Typical water quality problems that can arise from improper land use patterns are as follows:

- Poor distribution of point source waste discharges.
- Non-point discharges from urban and rural uses.
- Reduction in ground cover, floodplains, and wetlands.

The City of Marion covers approximately 1,904 acres of land in Crittenden County. Table 5-1 provides a breakdown of land use categories with the City. Residential use account for the largest percentage of the total developed area.

Table 5-1
Land Use in Marion, 2005[1]

Land Use Category	Acres	% of Total Area	% of Developed Area
Undeveloped	1,052	55.3	n/a
Residential	502	26.3	58.9
Commercial	87	4.6	10.2
Industrial	42	2.2	4.9
Public/Government	102	5.3	12.0
Recreational	119	6.3	14.0
Total Acreage	**1,904**	**100**	**100**

Notes: [1]Source: City of Marion Comprehensive Plan Update and Addendum, The Pennyrile Area Development District, 2006

Crittenden County comprises a total land area of 237,440 acres. Most of the developed area is in the City of Marion. In 2015, 93 percent of the County land area was undeveloped.

The planning area overlaps with the City Limits of Marion other than a few minor extensions. These areas are mostly urban and high density residential. The City is not much more than one square mile and has a population of 3,000 representing about one third of the county population. The majority of development can be expected to occur within the boundary areas during the planning period.

C. Hydrology

There are two major watersheds in the planning area: the Crooked Creek watershed, and the Rush Creek watershed. Crooked Creek flows northward along the western part of the Planning Area and is the largest Creek near Marion. Rush Creek drains the downtown Marion area flowing northward then merges with an un-named tributary near the existing WWTP. The eastern edge of the Rush Creek watershed is near the eastern edge of the Planning Area. Rush Creek then continues northward and enters Crooked Creek about 1 mile north of the northern edge of the Planning Area. Crooked Creek then flows approximately 15 miles before entering the Ohio River.

Based on the 2014 Kentucky Report to Congress on Water Quality, required by Section 305 (b) of the Federal Water Pollution Control Act of 1972, all waters within the planning area are supporting their designated uses. There are no known impaired streams within the planning area.

D. Land Features

Topography

The topography of the planning area can be characterized by a variety of irregularly shaped, sandstone-capped hills and ridges, as well as, the area is drained by a diverse stream pattern that has left a well-dissected upland. The orientation of some of the ridges and bluff's is influenced by the faulting that is so prevalent in the mineral district. Most elevations are in the range of 500 to 600 feet msl.

Soils

Soils within any area may be classified into separate and distinct soil associations. Each association consists of a combination of distinct soils in specified fractions, constant throughout a defined geographic area.

Characteristics defining soil associations are: drainage, permeability, slope, depth, type, and amounts of soils in the association. The composition of each association will have an effect on groundwater recharge, drainage, construction methods, and ultimately, development costs.

The U.S. Soil Conservation Service publishes soil surveys for every county. The survey for Crittenden County indicates that the county is located in the Mississippian Plateaus region and the classified soil types are the Alfisols order, Inceptisols order, and Mollisols order. These soils account for nearly 95 percent of soils present.

Alfisols soil have a thin, dark A-horizon rich in organic matter and nutrients, and a clay-enriched subsoil, and they are relatively fertile due to being only moderately leached. Alfisols may contain intact archaeological deposits very near or on the ground surface, depending upon the way they formed due to the existing landform.

Inceptisols soil develop in silty, acid alluvium during the Late Pleistocene or Holocene time periods on nearly level to steep surfaces, and deeply buried archaeological deposits, depending on the land topography. Inceptisols exhibit a thick, dark colored surface horizon rich in organic matter and a weakly developed subsurface horizon with evidence of weathering and gleying.

Mollisols soil are grassland soils that have a surface horizon that is thick, dark, and fertile, and can exhibit clay, sodium and/or carbonate enriched, or even leached subsoil horizons which increases the soils permeability. These soils form on level to sloping ground and have the potential to contain deeply buried and intact archaeological deposits on level floodplain or terrace landforms.

The project area is mapped within the Zanesville-Loring-Frondorf soil association. The specific soil series mapped within the project area are Hosmer silt loam and Zanesville silt loam. Hosmer and Zanesville series soils are classified as Alfisols, which are deep, sloping, moderately well drained soils.

The hilly nature of the Marion planning area, as well as high groundwater in some sections, limit structural and foundation alternatives. Shallow depth to bedrock can sometimes provide good foundation conditions, or can sometimes require costly excavation. The varying geophysical

and hydrologic characteristics of the planning area require site-by-site engineering investigations to determine impacts on sewage treatment and collection facilities.

A copy of the Preliminary Geotechnical Investigation for the proposed WWTP site is included in *Appendix U*.

E. Climate and Precipitation

The Marion area has a mild and moist climate. The average annual temperature is approximately 57ºF. Given its latitudinal and continental location, there is a substantial variation (seasonally) in temperature readings. The maximum range recorded to date is 130ºF (107ºF to -23ºF).

The Marion area normally receives about 46 inches of precipitation per year. The mean annual snowfall is about 12 inches. The area receives precipitation on an average of 116 days of the year (32%). Of these rainy days, 43 are (on average) classified as having at least one thunderstorm.

F. Floodplain

Appendix D includes the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for the planning area. Wetland maps for the planning area are provided in *Appendix E* and *Appendix F* as attachments.

G. Water Supply

Area water supplies include the Ohio River which forms the northwestern boundary of the County.

The Marion Water Treatment Plant (WTP) serves the City of Marion with potable drinking water. Raw water sources for the City include City Lake, which is formed by an impoundment on the upper end of Crooked Creek; and Lake George, which is formed by an impoundment of an un-named tributary to Crooked Creek upstream of City Lake. All other areas of the County are served by the Crittenden-Livingston Water District.

H. Groundwater

Groundwater is contained and transported by the Ohio River Alluvium in the Mississippian Plateau Region, and is composed of soils derived from sedimentary Quaternary era rocks, which were created during the Pennsylvanian period. Water from the Ohio River Alluvium is

hard to moderately hard, but generally of good quality. Common salt and hydrogen sulfide are the two naturally occurring constituents most often encountered in the groundwater within the region. High groundwater within the planning area limits structural and foundation alternatives, especially those along stream beds and low-lying areas.

I. Air Quality

Any improvements to the wastewater collection and treatment system recommended in this Facilities Plan are not expected to adversely affect the area's air quality.

J. Biotic Communities

The Marion planning area supports a diverse assortment of wildlife. The United States Department of the Interior, Fish and Wildlife Service, has identified species in Crittenden County that are endangered and/or threatened. The listing of species and a letter from the Department is included in *Appendix F* along with attachments identifying wetland areas. Before the implementation of any project related to the Facilities Plan, the Fish and Wildlife Service shall be contacted with detailed information on construction activities on a case by case basis.

K. Archaeology

The Kentucky Heritage Council has been notified of the potential for construction with the Marion planning area boundary. Land is being acquired for the construction of the Marion WWTP. A professional archaeologist has determined that no archaeological sites are eligible for listing in the National Register of Historic Places.

A copy of the Phase 1 Archaeological Investigation for the proposed WWTP site is included in *Appendix V*.

L. Water Quality Objectives

The water quality objectives for this Facilities Plan are the same as mandated by the Federal Clean Water Act, which are to prevent degradation and maintain the quality of the area's surface waters. Pursuant to the Kentucky Revised Statutes (KRS) 224.034, the Marion WWTP must comply with its Kentucky Pollutant Discharge Elimination System (KPDES) permit. A copy of the current permit is included in *Appendix G*. The current KPDES permit discharge limits are listed in Table 5-2.

Table 5-2

Marion WWTP KPDES Effluent Limits and Monitoring Requirements

Parameter	Effluent Limits				Monitoring Requirements
	Lbs/d		Other Units		
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	
Flow Design (0.66 MGD[1])	N/A	N/A	Report	Report	Continuous
$CBOD_5$[2]	110	165	20 mg/L	30 mg/L	1/week, composite
% Removal $CBOD_5$			85%		calculated
TSS[6]	165	248	30 mg/L	45 mg/L	1/week, composite
% Removal TSS			85%		calculated
E. Coli (N/100 ml)	N/A	N/A	130	240	1/week, grab
NH_3-N[7]	22 55	33 83	4.0 mg/L[4] 10 mg/L[5]	6.0 mg/L[4] 15 mg/L[5]	1/week, composite
Dissolved Oxygen	N/A		7.0 mg/L (minimum)		1/week, grab
Total Residual Chlorine	N/A		0.011 mg/L	0.019 mg/L	1/week, grab
pH	N/A		6.0 – 9.0		1/week, grab
Total Phosphorus	N/A		Report (mg/L)		1/week, composite
Lead, Copper, Zinc, Cadmium, Hardness (as $CaCO^3$)	N/A		Report		Less than 1/week composite

Notes:
[1]MGD – Million gallons per day
[2]BOD_5 – Five-day biochemical oxygen demand
[3]mg/L – Milligrams per liter
[4]Effective May 1 – October 31
[5]Effective November 1 – April 30
[6]TSS – Total suspended solids
[7]NH_3-N – Ammonia nitrogen
[8]Chronic toxicity unit

Section 6 – Existing Wastewater System

A. Purpose

The purpose of this chapter is to:

- Describe the existing collection system.
- Locate and describe significant non-sewered regions within the planning area.
- Provide background information regarding the existing Marion wastewater treatment plant (WWTP) and other smaller plants in the planning area.
- Identify the number, qualifications, and training of operating personnel.
- Evaluate the performance capabilities of the existing WWTP processes.
- Evaluate the physical condition and mechanical reliability of the existing WWTP process equipment.
- Identify existing industrial users within the planning area and the extent of industrial pretreatment.
- Identify ongoing studies/reports regarding the sanitary sewer collection system and discuss problems associated with infiltration and inflow (I/I).
- Discuss the need for the project and identify objectives of the Agreed Order to Correct Violations between the Division of Water (DOW) and the City of Marion.

B. Collection System/Pump Stations

The majority of the City of Marion (City) sewered area is served by a conventional gravity sanitary sewer collection system. *Figure 6-1* is a map which illustrates the existing sewered area, along with the existing unsewered areas within Marion's city limits. The city maintains approximately 131,900 linear feet of gravity sanitary sewer lines and 6 pump stations. A map of the collection system and pump stations is presented as *Appendix H.* The most prevalent pipe material in the system is vitrified clay pipe (VCP) which makes up about 62% of the gravity system. The second most common material in the system is polyvinyl chloride (PVC) which makes up 36% of the gravity system. The downtown area is oldest part of the system and dates back to the 1920's and 1930's in some areas. There is also some ductile iron pipe (DIP) in the system; the primary locations are at railroad, highway, and stream crossings. Table 6-1 lists the

linear footage of sanitary sewer lines in the city by type. Lateral sewers in the system (not listed below) consist of VCP, PVC, and Orangeburg pipe.

Table 6-1
Existing Sanitary Sewers by Type of Pipe

Type of Pipe[1]	Linear Footage in System (feet)[2]
Polyvinyl Chloride (PVC), Gravity	49,300
Vitrified Clay Pipe (VCP), Gravity	82,600
Force Mains	14,000
Total Footage	**145,900**

Notes: [1]8-inch gravity and larger
[2]Source: City of Marion and Eclipse Engineers GPS Mapping

The City's pump stations are listed in Table 6-2 and shown schematically in *Figure 6-2.* The northern half of the system flows by gravity directly to the WWTP parallel to Rush Creek. Only one pump station is located in this half of the system – the Sturgis Road Pump Station (PS). This PS collects a small group of homes that couldn't be served by gravity and was installed around 2009. Flow is pumped through a 4-inch force main which discharges into the gravity system near the intersection of Harmon Road and US 60 East (Sturgis Road). From this location, flow is by gravity to the WWTP.

The southern half of the system collects mostly by gravity to one location on the west end of the system where it is pumped by the City's largest pump station – the KY 91 PS. This PS originally consisted of duplex system that pumped flow through an 8-inch DI force main and discharged into the gravity system near Jackson Road. In 2005, a second wetwell and duplex system with larger pumps and a 12-inch PVC force main was constructed and the wetwells were conjoined to serve as a single system. The older pumps and force main serve as the lead PS and the larger duplex serves as a wet weather PS. Both parallel force mains discharge into the same manhole.

Smaller duplex pump stations serve pockets of homes in the southern area of the system that eventually flow through the KY 91 PS. These pump stations include the West Cruce Lane PS (constructed in 2009) which pumps flow through a 4-inch force main, the Airport Road PS (constructed in 2013) which is a duplex grinder PS which pumps flow through a 1.5-inch force main, and the US 60 West PS (constructed in 2012) which pumps flow through a 4-inch force main. Many residential grinder pump stations are located in the southern half of the system as well.

Table 6-2

Pump Station Inventory

Pump Station		Data				
No.	Name	Pump Rate (GPM[1])	TDH[2] (feet)	No. of Pumps	Pump Type	Pump Manufacturer
1	KY 91	1300	140	2	Submersible	Hydromatic
2	West Cruce	160	30	2	Non-Clog Submersible	ABS
3	Sturgis Road	140	38	2	Non-Clog Submersible	ABS
4	US 60 West	130	34	2	Non-Clog Submersible	ABS
5	Airport Road	9-13	45	2	Semi-PD Grinder	E-One
6	West Carlisle	9-13	20	2	Semi-PD Grinder	E-One

Notes: [1]GPM – Gallons per minute [2]TDH – Total dynamic head

C. Combined Sewers

City of Marion's sanitary sewer system is a totally separate system, i.e., there are no known combined sewers. Cross-connections between the sanitary sewer system and the storm sewer system may exist, but the City's staff has yet to identify any such cross-connections.

D. Unsewered Areas

As mentioned above, *Figure 6-1* is a map that illustrates the existing unsewered areas within Marion's city limits. A major effort has been made by the City of Marion to provide service to most of the previously unsewered areas within the city limits. However, isolated areas of residential and commercial customers within the service area remain without sewer service. It is estimated that these areas combined contain 75 to 80 accounts (approximately 187 people) served by on-site disposal systems. It is not anticipated that any additional development could occur in these areas if sewer services are made available.

All of the land outside the planning area is without sewer service. In general, this area does not contain much development; what does exist is primarily low-density residential development served by on-site disposal systems. The City does not anticipate adding these unsewered areas as customers during the planning period.

E. Other Wastewater Treatment Plants

The City of Marion owns and operates the only WWTP in Crittenden County. No other KPDES permits have been permitted or needed. There are no package treatment plants in the City. All of the county schools and all industries are served by the City.

Marion WWTP

The Marion WWTP is located adjacent to the Rush Creek in the northeastern portion of the city. The existing process flow schematic is presented as *Figure 6-4*. The existing treatment facilities were placed into service in 1971 and expanded in 1988 (finishing ponds) and 2010 (influent pump station) and include the following process facilities:

- Influent Submersible Chopper Pumps
- Aeration Basins (2)
- Secondary Clarifiers (2)
- Finishing Ponds (2)
- Chlorine Contact Basin
- Sludge Aeration Basin

- Drying Beds

The Marion WWTP has a current permitted design capacity of 0.66 MGD. It was designed in the early 1970's to treat low-strength wastewater. In 2015, the average day influent BOD_5 concentration was 89 mg/L, and the average day influent TSS concentration was 159 mg/L. Although the plant effectively treats both BOD and TSS during normal flow, wet weather cannot hydraulically be contained in the plant which results in SSO's at the influent pump station and/or the collection system near the plant. The peak hourly capacity of the plant is determined to be around 2.5 MGD before the aeration system cannot keep up.

Major WWTP process equipment at the Marion WWTP is summarized in Table 6-3 and in the following paragraphs:

Liquid Treatment Facilities

Two (2) submersible chopper pumps, rated at 3.0 MGD each, were constructed in 2010 to lift influent flows to the aeration basins. From the aeration basins, the mixed liquor flows via gravity to the clarifiers, finishing ponds, and chlorine contact chamber. During wet weather events, flow can increase to 5.0 MGD. Once the influent pumps reach a speed equal to about 2.5 MGD, the aeration basins cannot contain the mixed liquor due to undersized piping, etc. and the flow is therefore maintained around 2.5 MGD. Any excess influent flow is diverted and blended with the effluent flow and documented as a bypass event.

Table 6-3
Marion WWTP Process Equipment

1. Influent Pumps	
▪ Type	Submersible, Chopper
▪ Number	2
▪ Capacity	3.0 MGD each, VFD
2. Aeration Basins	
▪ Number	2, Series Flow
▪ Diameter	50 feet
▪ Sidewater Depth	12 feet
▪ Vertical Aerator	25 HP
3. Secondary Clarifiers	
▪ Number	2
▪ Diameter	30 feet
▪ Sidewater Depth	12 feet
▪ Overflow Rate at 5.0 MGD, Qp	3,536 GPD/ft^2
4. Post Aeration (Finishing Ponds)	
▪ Number	2
▪ Diameter	160 feet
▪ Sidewater Depth	8 feet
▪ Volume	150,000 gallons
▪ Overflow Rate at 5.0 MGD, Qp	124 GPD/ft^2
5. Chlorine Contact Chamber	

▪ Number of Chambers	1
▪ Length	70 feet
▪ Width	5 feet
▪ Depth	5 feet
▪ Volume	13,000 gallons
▪ Detention Time @ 5.0 MGD, Qp	4 minutes

In the aeration basins, the mixed liquor is maintained around 3,000 mg/L. Flow is then distributed evenly to the two (2) clarifiers. The settled sludge is then drawn off with belt-driven RAS pumps and returned to the first aeration basin. Clarifier effluent is distributed evenly to the two (2) large finishing ponds which provide additional fine settling and post aeration. The flow then enters the chlorine contact chamber and is measured with a v-notch weir ultrasonic level indicator. Disinfected wastewater is discharged to Rush Creek.

F. Sludge Handling and Treatment Facilities

Waste activated sludge is transferred from the clarifiers to an aerated sludge holding tank before it is emptied onto the drying beds. The six (6) drying beds are approximately 35 feet x 60 feet each. The dried sludge is trucked away and disposed of at the local landfill.

G. Process Evaluation

A process evaluation was conducted by evaluating each major facility on an individual basis, according to established criteria applicable to the facility. The evaluation utilized criteria contained in Recommended Standards for Wastewater Facilities, Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 1997.

Findings

The findings of the evaluation of all of the facilities are summarized in Table 6-4, and in the following paragraphs.

Table 6-4
Marion WWTP Unit Process Capacities

Unit Process	Facilities	Evaluation Criteria	Equiv. Avg. Day Flow (ADF) Cap. (MGD)	Percent of Permitted Capacity	Comment
Grit Removal	None	n/a	n/a	n/a	Although grit is not a major concern, without screening, all grit is entering the system.

Influent Pumping	Two submersible pumps-at 3.0 MGD each	Largest unit out of service, pump peak hour flow	3.0	100% ADF 67% QP	Cannot pump Qp with largest pump out of service
Screening	None	n/a	n/a	n/a	Without screening, the effectiveness of the aeration system is reduced.
Aeration Basins	Two 30-ft diameter basins with 25 HP surface aerators.	<=40 lbs BOD/1000 c.f.	0.88	1.33% ADF	Adequate treatment for ADF but cannot contain mixed liquor above 2.5 MGD. Loses freeboard.
Secondary Clarification	Two 30-ft diameter clarifiers, total surface area = 1,414 s.f.	Hydraulic loading less than 1,200 gpd/sf during Qp.	n/a	34% Qp	Clarifiers are vastly undersized for Qp.
Post Aeration (Finishing Ponds)	Two 160-ft diameter ponds, total surface area = 40,212 s.f.	n/a	n/a	n/a	Provides additional settling during Qp.
Disinfection	One chamber, total volume = 13,000 gallons. 150# cylinders.	15 minutes detention @ peak flow rate, 30 minutes detention @ average day flow rate; Cl_2 feed=6 mg/L	0.66	100% ADF 27% Qp	Adequate detention time for ADF but not for Qp.

Although the secondary clarifiers are the “limiting unit process” and defines the overall rating of the Marion WWTP, the aeration basins cannot contain the maximum amount of flow capable of being pumped which is 3.0 MGD. All flow above 2.5 MGD is bypassed and “blended” with the effluent.

In summary, most of the Marion WWTP facilities are adequately sized to treat 0.66 MGD on an annual average basis even though the current average daily flow is 0.82 MGD (or 124%). However, given the historical hydraulic peaking factors, almost all of the WWTP facilities including the site piping are undersized to treat the peak hourly flow.

H. Physical Evaluation

Physical Condition/Mechanical Reliability of Process Equipment

Each of the unit processes was evaluated to determine physical condition and continued reliability operating at its optimum or needing improvements. The results of this evaluation are as follows:

- **Influent Pump Station** – Two submersible chopper pumps were placed into service in 2010. Each pump is rated for 3.0 MGD. All electrical, controls and piping systems were installed and, therefore, the influent pump station is in good condition and has a high mechanical reliability. Wetwells are piped together for additional storage.

- **Biological Treatment (Circular, Aeration Basins)** – The structural integrity of the above-ground steel aeration basins have deteriorated over the years and have been repaired by welding supporting steel in places. The aerators rarely cycle off. Due to the poor physical condition of the system, the remaining useful life of the system is short.

- **Secondary Clarification** – The clarifiers have a poor design and constantly show signs of poor treatment ability. The physical condition of this system is acceptable; however, due to the age and poor design, the mechanical reliability is inadequate.

- **Disinfection (Chlorine Contact Basin and Chlorination System)** – The contact basin is in fair condition but is almost always covered in algae due to the upstream systems ineffectiveness The system is in fair physical condition and is mechanically reliable.

- **Post Aeration (Finishing Ponds)** – These ponds are used for post aeration but undoubtedly provide much need final settling as well. The inlet and outlet piping is undersized for peak hourly flow. The surface aerators that are used have difficulty aerating the edges of the ponds. The physical condition and mechanical reliability is fair.

- **Effluent Flow Measurement** – As effluent flows from the chlorine contact chamber it falls freely over a fixed v-notch weir where a flow meter/chart recorder measures and records effluent flows. The physical condition and mechanically reliability is fair.

- **Aerobic Digesters** – The Aerobic digester is similar in design to the aeration basins, consisting of a surface aerator in an above ground steel tank. The tank and equipment are nearing the ends of their useful lives.

I. Operations and Maintenance Staff

Wastewater system operation and maintenance (O&M) for the City of Marion is performed by a staff of nine employees. Table 6-5 provides a list of the wastewater system O&M personnel.

Table 6-5
Marion Wastewater System Operations and Maintenance Staff

Title/Classification	Number
Utility Director	1
Chief WWTP Operator	1
WWTP Operators/Maintenance	1
Collection System Maintenance	6
Total Employees in Wastewater System	**9**

J. Wastewater Characteristics

The Marion WWTP has a mixed customer base consisting of domestic, commercial and industrial customers. The industrial component has a very little impact on the characteristics of the wastewater.

Influent and effluent wastewater characteristics for the years 2014 is summarized in Table 6-6. Table 6-7 summarizes monthly flow data for calendar year 2014. Additional influent and effluent MOR data is summarized in Appendix W.

Table 6-6
2014 WWTP Wastewater Characteristics Summary

Constituent	2014		KPDES[2] Effluent Limits[3]
	Average Influent	Average Effluent	
Flow (MGD)[4]	n/a	0.82	0.66
BOD_5[5] (mg/L)[6]	126	3.8	20
TSS[7] (mg/L)	156	4.0	30
NH_3-N[8] (mg/L)	13.3	2.5	4 summer / 10 winter

Notes:
[1]Developed from Discharge Monitoring Reports submitted to Kentucky Division of Water
[2]KPDES – Kentucky Pollutant Discharge Elimination System
[3]Monthly average
[4]MGD – Million gallons per day
[5]BOD_5 – Five-day biochemical oxygen demand
[6]mg/L – Milligrams per liter
[7]TSS – Total suspended solids
[8]NH_3-N – Ammonia nitrogen

Table 6-7
2014 Influent Wastewater Characteristics

Month	Rain (in.)	Influent Flow		Monthly Average BOD_5		Monthly Average TSS		Monthly Average NH_3-N	
		Monthly Average (MGD)	Max Day (MGD)	(mg/L)	(lbs/d)	(mg/L)	(lbs/d)	(mg/L)	(lbs/d)
Jan-14	1.76	1.01	1.81	93	783	134	1129	14.8	125
Feb-14	2.83	1.30	1.81	118	1279	118	1279	11.7	127
Mar-14	3.83	1.11	1.81	160	1481	183	1694	13.9	129
Apr-14	9.61	1.18	1.41	141	1388	186	1830	8.2	81

May-14	5.47	0.97	1.89	111	898	156	1262	10.6	86
Jun-14	6.50	0.98	1.87	83	678	110	899	10.1	83
Jul-14	0.67	0.47	0.73	144	564	170	666	16.2	64
Aug-14	2.62	0.41	0.75	169	578	130	445	22.2	76
Sep-14	1.35	0.41	0.70	154	527	174	595	18.1	62
Oct-14	4.87	0.57	1.45	145	689	194	922	13.7	65
Nov-14	2.69	0.62	1.37	127	657	148	765	13.6	70
Dec-14	3.51	0.90	1.64	77	578	158	1186	8.0	60
2014 Avg.	3.81	0.82	1.89	126	842	156	1056	13.3	85

Note: Flow is based on effluent flow meter readings

Table 6-8
2014 WWTP Effluent Data

Month	Average Effluent Flow		Monthly Average Effluent BOD_5			Monthly Average Effluent TSS			Monthly Average Effluent NH_3		
	Month (MGD)	Max. Day (MGD)	(mg/L)	(lbs/d)	Removal (%)	(mg/L)	(lbs/d)	Removal (%)	(mg/L)	(lbs/d	Removal (%)
Jan-14	1.01	1.81	6	51	93	5	42	96	3.4	29	77
Feb-14	1.30	1.81	6	65	95	5	54	96	3.8	41	68
Mar-14	1.11	1.81	6	56	96	5	46	97	3.6	33	74
Apr-14	1.18	1.41	4	39	97	3	30	98	2.6	26	68
May-14	0.97	1.89	4	32	96	3	24	98	2.9	23	73
Jun-14	0.98	1.87	3	25	96	4	33	96	2.9	24	71
Jul-14	0.47	0.73	3	12	98	3	12	98	3.4	13	80
Aug-14	0.41	0.75	3	10	98	3	10	98	2.8	10	87
Sep-14	0.41	0.70	2	7	99	3	10	98	2.2	8	87
Oct-14	0.57	1.45	2	10	99	2	10	99	1.6	8	88
Nov-14	0.62	1.37	3	16	98	5	26	97	0.5	3	96
Dec-14	0.90	1.64	4	30	95	4	30	97	0.6	5	92
Average	0.82	1.89	4	29	97	4	27	97	2.5	19	80

Note: Values that exceed permit limits are shown in **bold.**

K. Industrial Pretreatment

The City does not have an industrial pretreatment program. Few industries are located in Marion and water use for those industries is minimal.

L. Infiltration/Inflow Study

Marion has struggled to reduce wet weather flow coming to the WWTP. The majority of the collection system consists of clay pipe that is very old. In 2004, a major collection system improvements project was completed which upgraded the KY 91 Pump Station and replaced the 18-inch clay trunk sewer with a 24-inch pvc line. This moved all SSO's to the WWTP or within 1 manhole from the influent pump station. In 2007, a *Flow Monitoring Study* was completed which discussed the results from two overflow meters strategically placed near the WWTP to quantify

the SSO's. In total, Marion bypassed an estimated 71 MG in 2007. This equates to 0.20 MGD which never reached the WWTP.

A copy of the Flow Monitoring Study is included in *Appendix X.*

O. Need for the Project

The city was issued an *Agreed Order* signed July 29, 2016 which directs to the city to construct a new WWTP and cease all bypasses associated. The new WWTP shall be operational in 5 years from the executed date, or July 29, 2021.

In response to the AO, the city had to create a Corrective Action Plan (CAP). The CAP was submitted and accepted on January 27, 2017.

A copy of the Agreed Order is included in *Appendix K*. A copy of the Corrective Action Plan is included in *Appendix L.*

N

FIGURE 6-1

0 700 1,400 2,100 Feet

City of Marion, Kentucky
Unserved Properties

Unserved Properties

Marion Topographic Quadrangle
Crittenden County, Kentucky

ECLIPSE ENGINEERS, PLLC
113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959

City Of Marion, Kentucky
Pump Station Schematic

Gravity Sewer

Force Main

N.T.S.

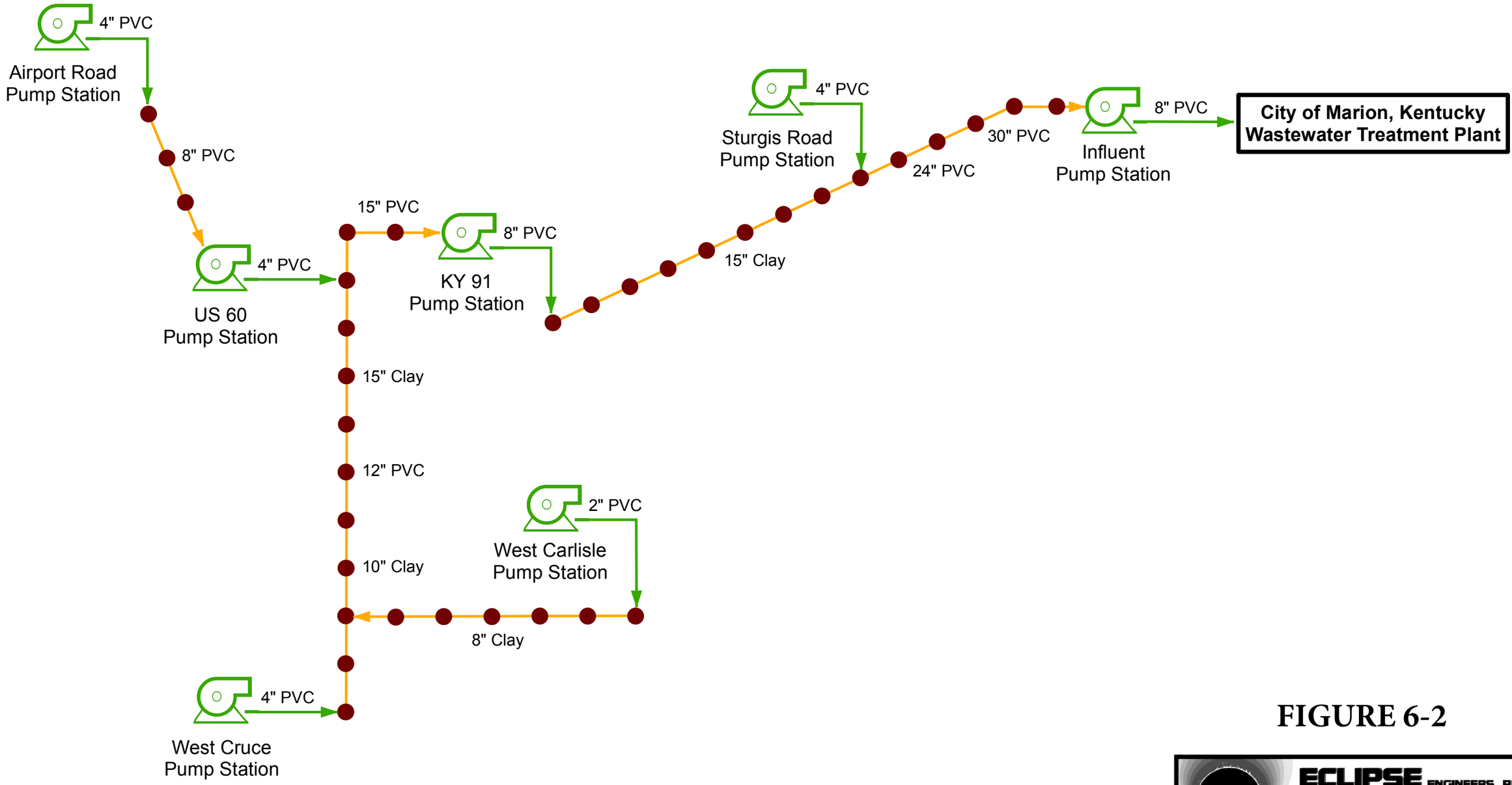

FIGURE 6-2

ECLIPSE ENGINEERS, PLLC
113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959

SITE PLAN

SCALE 1"=400'

FIGURE 6-3

MARION WASTEWATER TREATMENT PLANT
CITY OF MARION
217 S. MAIN STREET
MARION, KENTUCKY 42064

ECLIPSE ENGINEERS, PLLC
113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
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City Of Marion, Kentucky
WWTP Flow Schematic

RAS - Return Activated Sludge
WAS - Waste Activated Sludge

N.T.S.

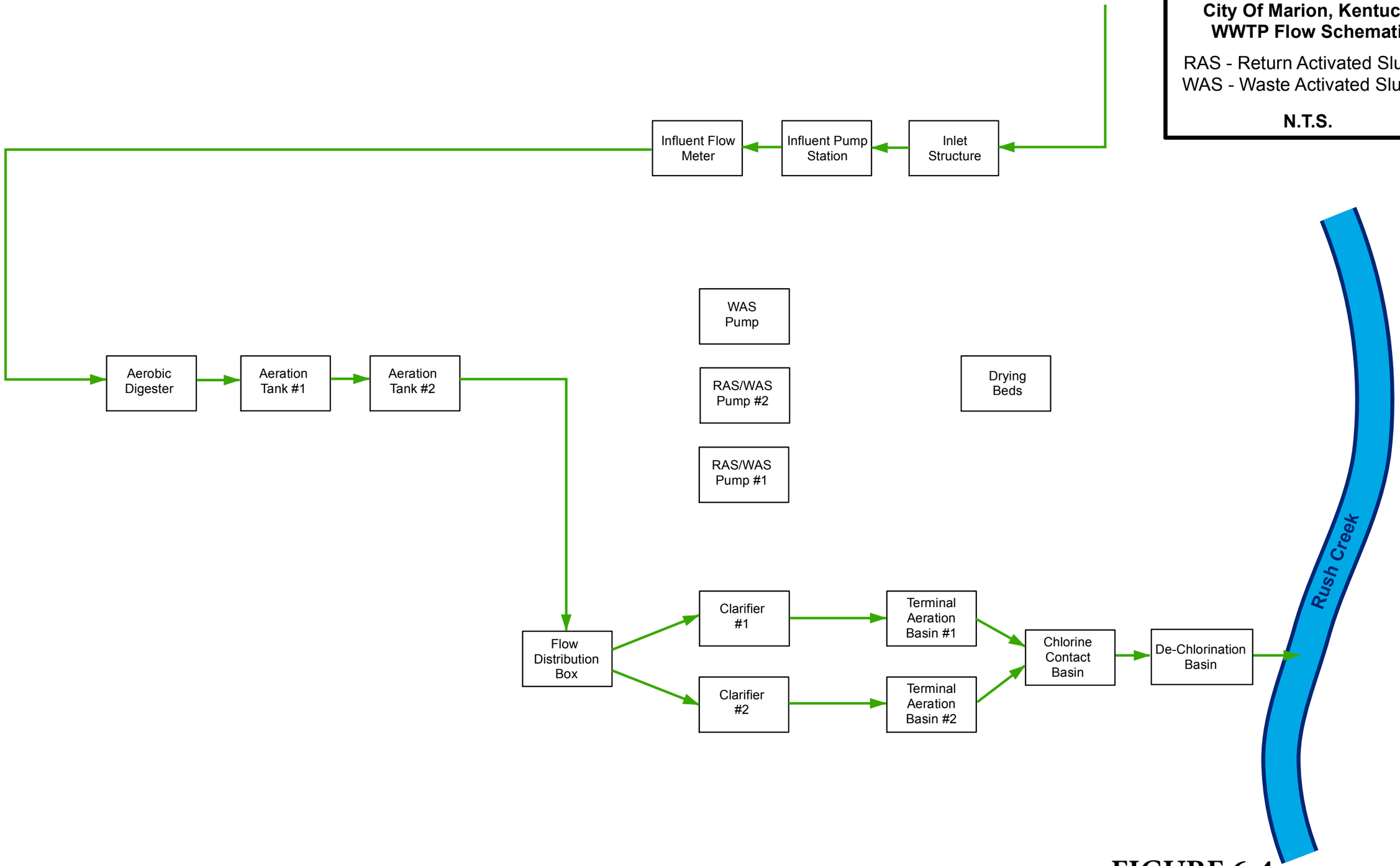

FIGURE 6-4

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Section 7 – Forecast of Flows and Waste Loads in the Planning Area

A. Purpose

The purpose of this chapter is to:

- Present population trends and projections
- Evaluate water consumption within the service area and compare to wastewater treatment needs
- Develop wastewater flow and loading projections for the planning period

B. Population Trends and Projections

Current Population

The 2010 U.S. Census population counts for Crittenden County and the City of Marion are 9,315 and 3,002 respectively. The planning area boundary is almost identical to the City Limit of Marion plus a small area of homes west of the City. Thus, the planning area comprised approximately 33 percent of the total county population in 2010.

An estimate was made of the 2017 wastewater system service population based on the estimated number of residential wastewater system customers, and census-derived persons per housing unit. In 2017, the sewer system served 1,254 residential customers. This corresponds to a service population of 3,135 based on 2.5 persons per household and is aligned with the population figures as well.

Population Projections

Population projections are based on the Kentucky State Data Center's projection of county population. This agency is the official source for population data/projections for Kentucky. It forecasts population county-wide and, therefore; projections for cities must be taken from the U.S. Census Bureau.

Crittenden County population projections for the years 2020, 2030, 2040 were used as the basis for projecting planning area and wastewater system service populations as follows:

- As noted above, the percentage of county population residing within the planning area was 33 percent in 2017. This percentage of county population in the planning area was assumed to remain constant throughout the planning period.

- From above, the estimated service population in the planning area was estimated to be 3,135 in 2017, or about 33 percent of the planning area population. This percentage was assumed to stay constant in 2020, 2030, and 2040 as the City population is expected to remain constant or slightly decrease.

The resulting planning area and service population projections are shown in Table 7-1. As indicated in Table 7-1, the service population is expected to slightly decrease, however the current population was held constant for planning purposes.

Table 7-1
1990-2040 County, Planning Area, and Wastewater Service Populations

Year	Crittenden County	City of Marion	Estimated/Projected Population of Planning Area[1]
1990	9,196	3,320	3,320
2000	9,384	3,196	3,196
2010	9,315	3,002	3,002
2020	*9,103*	*3,039*	*3,039*
2030	*8,828*	--	*2,948*
2040	*8,545*	--	*2,854*

Notes: [1]3,135 was used for planning purposes throughout this Facilities Plan

C. Base Wastewater Flow

The total wastewater flow received at the typical treatment facility represents a combination of several sources including:

- Wastewater purposely discharged to collection system.

- Groundwater infiltration.

- Surface water inflow.

To determine the per capita wastewater contribution, it is first necessary to quantify the flow without the influences of extraneous water. Therefore, base flow is the amount of wastewater discharged directly to the collection system, excluding the contribution by infiltration/inflow (I/I).

The "base flow" for the City of Marion (City) system has been determined by reviewing flow records for days in which the effects of I/I were considered negligible. 2014 Monthly Operating Reports (MOR's) were used in selecting non-rainfall days (see Table 7-2). During a 23-day period from July 16 to August 7, 2014, there was no rainfall other than a trace, and groundwater levels were low.

The total wastewater flow during the 23-day period was 9.26 million gallons. Therefore, the "base flow" equals 9.6 million gallons ÷ 23 days or 0.40 million gallons per day (MGD).

Table 7-2
2014 Dry Weather Wastewater Flows[1]

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.88	1.13		1.05	1.25		0.72	0.33	0.23	0.37	0.44	
2		1.36	0.98	1.24	1.18			0.48	0.41	0.52	0.42	
3					0.99		0.65	0.27	0.39			0.86
4	0.90	1.55	1.20		0.90	1.62	0.65	0.52	0.38		0.84	
5			1.23	1.27	0.84		0.51	0.39	0.39	0.38		
6			1.24	1.23	0.82		0.35	0.39	0.38		0.55	
7	0.90		1.34		0.76	1.40	0.50	0.41	0.35		0.59	0.84
8	0.91		1.28						0.47		0.45	0.85
9			1.16				0.59		0.37			0.75
10		1.05	1.27	1.24	1.08		0.46	0.44			0.56	0.68
11		0.98	1.24	1.31			0.46		0.67		0.46	0.63
12	1.60	1.01		1.26	0.83	1.07	0.53			0.52	0.45	0.63
13		1.17	1.02	0.91		1.11	0.47	0.41	0.44		0.43	0.56
14			1.08			0.80		0.40	0.25		0.42	0.57
15		1.45	1.11			0.73			0.40		0.42	0.76
16		1.15		1.28		0.69	0.41	0.25	0.39			
17		1.63		1.28	1.01	0.66	0.49		0.39	0.56		0.61
18	0.87		1.26	1.10	0.88	0.61	0.43	0.46	0.39	0.47	0.50	
19	0.99	1.67		1.01	0.98	0.74	0.43		0.40	0.42	0.65	0.60
20	0.62	1.60	1.01	0.92	0.82		0.29	0.42	0.39	0.43	0.48	0.54
21			1.03	0.91	0.78	0.52	0.46	0.40			0.51	0.55
22		1.34	0.87		0.80	0.53	0.41	0.40	0.40	0.80	0.49	0.66
23	0.79	1.05	0.79	0.81		0.99	0.43	0.40	0.40	0.42	1.31	
24	0.93	1.03	0.84	0.99	0.70				0.39	0.51		
25		0.95			0.59		0.41	0.38	0.38	0.47	0.79	
26	0.73			1.07	0.53	1.02	0.40	0.34	0.39	0.30	0.78	
27	0.73	0.88		1.01			0.27	0.35	0.43	0.42		
28	0.72	1.01			0.99		0.43	0.48	0.28	0.90	0.58	1.06
29	0.69				0.84	0.62	0.40		0.37		0.60	1.03
30	0.69		0.87		1.08	0.61	0.40	0.75	0.38	0.47	0.77	0.92
31	0.84		1.25				0.40					0.82
Total	13.79	22.01	22.07	19.89	18.65	13.72	11.95	8.67	10.51	7.96	13.49	13.92
# of Days	16	18	20	18	21	16	26	21	27	16	23	19

Note: [1]All Flows in Million Gallons per Day.

D. Water Consumption

Table 7-3 presents water sold during the year 2014. Water consumption by sewer customers represents almost all total water sold. It is assumed that 70% of the water used returns to the wastewater system. This number can then be used to determine the average daily flow. As shown in Table 7-3, the average daily flow is assumed to be 0.17 MGD based on water consumption.

Table 7-3
2014 Metered Water/Sewer Flows

Month	Water Usage (gallons)	Water Usage by Sewer Customers (gallons) (70%)
January	8,295,900	5,807,130
February	9,773,500	6,841,450
March	6,046,500	4,232,550
April	4,484,700	3,139,290
May	6,191,500	4,334,050
June	8,362,400	5,853,680
July	7,873,600	5,511,520
August	7,160,300	5,012,210
September	8,743,400	6,120,380
October	6,842,000	4,789,400
November	7,292,500	5,104,750
December	7,032,800	4,922,960
Total	**88,099,100**	**61,669,370**
Average Daily Water Use	**0.24 MGD**	
Average Daily Flow (sewer)	**0.17 MGD**	

E. Infiltration/Inflow Analysis

Planning and design of sanitary sewer collection and treatment systems must take into account extraneous water components which enter the sanitary sewer system. The two major sources of extraneous water are I/I. Infiltration is groundwater which enters the collection system through pipe joints, broken or cracked pipe, openings in manholes, and other subsurface imperfections. Inflow is the flow component which enters the collection system immediately following a rain event. Typical points of inflow include leakage through manhole covers, roof drain connections, and storm water inlet connections. Because infiltration and inflow each

represent a different flow component, it was necessary to calculate the respective flow separately.

Average infiltration is determined by subtracting the "base wastewater flow," as calculated previously in this chapter, from the average non-rainfall wastewater flow. The period used to determine the average non-rainfall flow is January 2014 through December 2014. Based on precipitation records, there were 241 days in 2014 in which Marion did not experience rainfall events. Therefore, no inflow occurred during the 241-day period. Table 4-2 provides daily wastewater flows for those non-rainfall days. A total flow of 176.6 million gallons (MG) was recorded by the wastewater treatment plant (WWTP) during the 241 non-rainfall days, resulting in an average flow of 0.73 MGD. Therefore, the average non-rainfall flow includes an average infiltration rate of 0.33 MGD (0.73 MGD – 0.40 MGD).

Maximum infiltration occurs during non-rainfall periods when groundwater is high. Precipitation data and seasonal groundwater fluctuations indicated that the period from April 16, 2014 through April 21, 2014 would yield a maximum infiltration rate. The total flow recorded at the WWTP during these six days was 6.5 million gallons. Therefore, maximum infiltration is calculated as follows:

- Maximum Infiltration = (6.5 MG ÷ 6 days) – Base Flow (0.40 MGD) = 0.68 MGD.

Maximum inflow occurs during periods of high intensity precipitation which may be accompanied by isolated flooding. An evaluation of the City collection system indicates significant inflow occurs during high intensity storm events. Storm water intrusion into the collection system has resulted in numerous overflows at or just prior to the WWTP. These SSO's occur primarily to the limitations placed on the influent pumps as to not overflow downstream processes. Consequently, artificially low influent flow measurements are recorded during high intensity storm events.

A 2007 study was conducted per the Division of Water to quantify the SSO's at the influent pump station. This *Flow Monitoring Study* is included in Appendix X. This study monitored two overflow meters that were installed for a period between June 2007 and March 2007. One meter was placed in the main trunk sewer in the last manhole before the influent pump station. The second meter was placed in the influent pump station. The overflow from these two meters were added and compared to rainfall measured at the WWTP. In summary, the meters measured 61 MG of overflow during these 10 months with 32 MG being measured in December 2007 alone. Extrapolating for April and May 2007, one could conclude that approximately 71 MG was overflowed, or 0.20 MGD in addition to the ADF from the MOR. The max day overflow recorded was around 6.0 MGD, however, it is believed that the manhole flow meter was compromised with creek water and therefore the flow is assumed to be much less. 50.69

inches of rain fell during the 10-month study which is slightly higher than the average. Adding this unaccounted flow to the 2014 ADF we have evaluated (0.82 MGD), we concluded that an actual annual ADF for Marion is 1.02 MGD.

The U.S. EPA guidelines for determining excessive I/I are defined as follows:

- Infiltration – If the average daily flow to the WWTP is 120 gpcd or less, infiltration is considered non-excessive. If the average daily flow is greater than 120 gpcd, further investigation of flows is required.

- Inflow – If the rainfall induced peak hydraulic flow rate at the WWTP exceeds 275 gpcd, the city shall perform a study of the sewer system to determine the quantity of excessive inflow and propose a rehabilitation program to eliminate excessive inflow.

From data provided in Table 3-9 and as discussed above, the average daily flow rate to the Marion WWTP is 1.02 MGD (0.82 + 0.20). The estimated number of persons per household in the City of Marion from the U.S. Census data is 2.50. Utilizing water usage data from Marion, the calculated Marion population equivalent (PE) for the wastewater system is as follows:

- Residential Customers: 1,254 (2014).
- Total Industrial Flow in 2014 was 9,176,200

- Number of People (Residential) Served by Sewer System: 1,254 residential customers x 2.50 people/customers = 3,135 people.

- Average Water Usage per Person: (88,099,100 total – 9,176,200 ind.) x 70% ÷ 3,135 people ÷ 365 days = 48.0 gpcd.

- PE: 241,367 gallons per day (total water use) ÷ 48.0 gpcd = 5,028 people.

The per capita average daily flow rate based upon a PE of 5,028 people is determined by dividing the average daily wastewater flow rate for 2014, less industrial flow returned to the sewer which is 1,020,000 – 25,140 = 994,860 GPD by 5,028 people and is equal to 198 gpcd. Since this calculated per capita daily flow rate is more than the allowable 120 gpcd, the city's sewer system is considered to have excessive infiltration.

The peak 24-hour hydraulic flow rate recorded at the Marion WWTP during the year 2014 was 1,890,000 GPD. As discussed, this is most the current influent pumps can convey without compromising downstream processes. In 2007, the influent pump station could only pump a peak flow of 1,000,000 GPD. Adding in an estimated bypassed peak hourly flow of 4,500,000 per the 2007 Flow Monitoring Study, we estimate the current peak hourly flow to be 5,500,000

GPD. The 2007 data gathered led to the replacement of the influent pump station in 2010. Therefore, very little flow more than the 2007 ADF was kept from bypassing at the time of the study.

The peak daily hydraulic flow rate less large industrial flow is, therefore, 5,500,000 GPD – 25,140 = 5,474,860 GPD divided by 5,028 or 1,089 gpcd which is greater than the allowable 275 gpcd. The Marion sanitary sewer system is, therefore, considered to be subject to excessive inflow.

F. Wastewater Flow Projections for 20-year Planning Period

Table 7-4 presents a summary of the previously calculated wastewater flows for the year 2014 and projected wastewater flows for the 20-year planning period. Wastewater flow projections for the year 2040 include the following considerations:

- All new residential units will require sewer services.
- All new commercial and industrial establishments will require sewer service.
- Per customer wastewater contribution for residential and commercial will not change significantly.
- Each residential customer represents approximately 2.5 people.
- Although likely to decrease, the quantity of infiltration is assumed to not increase as very little sewer extensions are expected during the planning period and a major collection system rehabilitation project will take place with this project.
- Although likely to decrease, the quantity of inflow is assumed to not increase as a major collection system rehabilitation project will take place with this project.

Table 7-4
Design Wastewater Flows[1]

Year	Type	Wastewater	
		Average Daily Flow	**Peak Flow Rate**
2014 Existing	Residential Major Industrial Commercial Infiltration Inflow	0.12[2] 0.03[3] 0.02[4] 0.33[5] 0.52[6]	0.18[7] 0.05[7] 0.03[7] 0.73[8] 4.51[9]
Total		**1.02**	**5.50**

2040 Projected	Residential	0.12[10]	0.18[7]
	Major Industrial	0.03	0.05[7]
	Commercial	0.02	0.03[7]
	Infiltration	0.33	0.73
	Inflow	1.00	5.01[11]
Total		**1.50**[12]	**6.00**

Note:
[1]All flows in million gallons per day (MGD).
[2]Total base flow of 0.40 MGD, of which only 30% is from residential customers.
[3]Determined to be 8% of the base flow rate per water use data.
[4]Calculated as 5% of the base flow rate.
[5]Calculated from dry weather chart
[6]Balance of ADF per 2014 MOR's and Flow Monitoring Report
[7]Peaking factor = 1.5 x average daily flow.
[8]Calculated from dry weather chart
[9]Balance of peak hourly flow per historical records and Flow Monitoring Report
[10]Data shows little to no population growth
[11]Estimated for future although anticipated to decrease
[12]Estimated to remain below 70% loaded

G. Wasteload Projections

In Chapter 6, it was shown that the Marion WWTP treats a relatively low strength wastewater. In 2014, influent five-day biochemical oxygen demand (BOD_5) concentrations averaged 126 milligrams per liter (mg/L). Influent total suspended solids (TSS) concentrations were also low, averaging 156 mg/L. The low BOD_5 and TSS concentrations are largely due to little industrial discharges to the sewer system and the high I/I entering the system and diluting the concentrations. Anticipating a successful collection system rehabilitation, it is likely that future BOD_5 and TSS raw sewage concentrations could increase slightly. In doing so, flow would most likely proportionally decrease resulting in similar lbs. per day loading.

Influent ammonia-nitrogen (NH_3-N) averaged approximately 13 mg/L in 2014. This is a fairly low ammonia value and is consistent with the low BOD_5 and TSS concentrations. It is anticipated that as excess infiltration/inflow is removed, the strength will increase to approximately 20 mg/L, which is a more normal value for raw sewage.

The Marion WWTP is not currently required to remove phosphorus and, therefore, does not regularly monitor influent phosphorus concentrations. However, the limited amount of recent data indicates that the Marion raw sewage has an average influent phosphorus concentration of approximately 3 mg/L. This is consistent with values typically encountered in raw sewage and could increase if flow decreases similar to NH_3-N.

Table 7-5 summarizes the projected flows, concentrations and mass loading of the sewered portion of the planning area for the year 2040.

Table 7-5
Wasteload Projections – Year 2040

Constituent	Design Flow Rate (MGD)[1]	Concentration (mg/L)[2]	Load (lbs/day)[3]
BOD_5[4]	1.50	200	2,502
TSS[5]		300	3,753
NH_3-N[6]		20	250
Phosphorus		10	125

Notes: [1]MGD – Million gallons per day
[2]mg/L – Milligrams per liter
[3]lbs/day – Pounds per day
[4]BOD_5 – Five-day biochemical oxygen demand
[5]TSS – Total suspended solids
[6]NH_3-N – Ammonia nitrogen

H. Capacity of Existing Facilities and Projected Growth

As noted in Chapter 6, the existing Marion WWTP capacity is constrained by several unit process facilities mainly from a peak hydraulic capability. The existing facilities are not capable of meeting treatment requirements on a consistent and reliable basis at the existing average daily flow rate of 1.02 MGD (0.82 plus bypassed influent) with the existing plant ADF rating of 0.66 MGD.

Flow and load projections presented in this chapter indicate that average day flows are not expected to increase. A new plant is needed primarily for peak hydraulic capacity as the existing processes are vastly undersized for the amount of flow received. Also, the existing plant is has long past the end of its useful life as much of the base construction was placed into service in 1972. Therefore, it can be concluded that the existing wastewater treatment facilities are not capable of meeting present or future load conditions consistently and reliably, and therefore, need to be expanded and upgraded.

Section 8 – Evaluation of Alternatives

A. Purpose

The purpose of this chapter is to:

- Discuss sewer alternatives.
- Define future effluent requirements.
- Discuss the "No Action Alternative."
- Identify alternatives for providing wastewater treatment.
- Analysis of principal alternatives.
- Present the selected alternative.

B. Collection Sewer Alternatives

Over the 20-year planning period, improvements to the collection system will be needed. These improvements will take place immediately (0-2 year) with a $2 million project. These improvements will include miscellaneous rehabilitation work and the infiltration/inflow reduction program. Very few if any extensions are anticipated. Costs have been estimated based on discussions with general contractors, review of previous construction bids, existing equipment and material prices, and an understanding of the project area.

No Action Alternative

This action involves no initial construction and no action other than maintaining and operating existing facilities. Existing facilities are failing and are not sized for the peak hourly flow measured for years. The "No Action" alternative will continue the degradation of ground water and surface water systems in the planning area, and an eventual ban on any type of development could be imposed. The City of Marion has entered an Agreed Order with the Division of Enforcement based upon these actions. Therefore, this alternative is not feasible for the sewer collection system and no further evaluation will be given to this alternative.

Future Collection System Service Areas

In the 0-2 year planning period, many areas of the collection system will be rehabilitated or replaced. These areas have been identified through knowledge of City staff and through an

updated SSES being developed. Future efforts will continue after this initial project is completed. The areas which will be addressed immediately are illustrated in *Appendix J*.

- Area B (Watershed B) – This area is located on the north end of Marion and consists of the subdivision Greenwood Heights. Existing sewers are 4" and 8" clay and some lines do not have manholes where needed. Streets proposed to have the existing sewer slip lined include Harmon Drive, Hillcrest Drive, Meadow Drive, Summit Drive, and Whipporwill Drive.

- Area C – This area is located on the east end of Marion. The line proposed to be replaced is 8" clay and serves as the trunk line for this watershed. The line is located just south of the City-County Park near the east branch of Rush Creek. The line will be addressed by both dig and replace and slip lining methods. Streets nearby include Old Morganfield Road, Guess Drive and Club Drive.

- Area E – This area is located on the north central end of Marion and will include five separate areas of improvement. Existing sewers consist of 4", 6", 8", 10", and 15" clay. The lines will be addressed by both dig and replace and slip lining methods. North Weldon Street is the only street that is continuous with this area. Other lines follow drains and cross various streets perpendicularly.

- Area F – This area is located on the east end of Marion, south of KY 120. Existing sewers are 4" clay and are undersized. The lines will be replaced with 8" pvc by dig and replace. Streets nearby include Maxwell Street, Clark Street, Kevil Street, and East Carlisle Street.

- Area G – This area is along South Main Street on the south end of Marion. Existing gravity sewer along South Main Street is 10" clay between Old Piney Road and East Cruce Lane. This line will be addressed by slip lining to minimize traffic impact.

- Area J – This area is on the southwest end of Marion near the Marion County Club. Existing sewer 4", 6", 8", and 15" clay. These lines will be addressed by slip lining to minimize disturbance of the gold course and homeowner properties. Streets proposed to have sewer slip lined include Hickory Hill Avenue and Leland Avenue and Leland Court, and Watson Street.

- Area P – This area is on the west central end of Marion along US 60 West and Yandell Street. Existing sewers consist of 8" clay. These lines will be addressed by slip lining. Streets proposed to have sewer slip lined include Chipps Drive, Blackburn Street, and crossing various other streets as the line following the existing drainage path.

Other than the "No Action" alternative, there are two collection system alternatives: 1) expanding by the use of conventional gravity sewers, or 2) expanding by the use of low pressure sewer.

Conventional Gravity Sewer

Conventional gravity sewers are a system of 8-inch and larger collection mains with manholes located at every vertical/horizontal change or a maximum of 400-foot intervals. This type of system will also incorporate pump stations and force mains to transport wastewater.

Opinions of probable construction and total costs were calculated based on discussions with general contractors, construction bids, equipment and material prices, and a general understanding of the project area. A summary of cost for each area is presented in Table 8-1. This itemized cost for each area is presented in *Appendix J, Tables J-1 through J-7*.

Table 8-1
Summary Table
Gravity Sewer System Opinion of Probable Cost[1]

Service Areas	Construction Cost	Development Cost[2]	Contingency Cost[3]	Total Opinion of Probable Cost
B	$327,000	$36,500	$32,700	$359,700
C	214,900	35,000	21,490	236,390
E	406,000	54,000	40,600	446,600
F	192,500	29,500	19,250	211,750
G	200,000	23,500	20,000	220,000
J	473,000	57,000	47,300	520,300
P	79,500	9,500	7,950	87,450
TOTAL	$1,892,900	$245,000	$189,290	$2,327,190

Notes: [1]All costs in 2017 dollars.
[2]Development costs are based on the collection system portion of the total development cost.
[3]Contigency costs are based on 10-percent of construction costs.

Low Pressure Sewer

Small diameter pressure sewers are needed in some areas of Kentucky due to geographical constrictions such as steep hills, creeks, and mountains. Although western Kentucky is typically flat and fits well with gravity sewers, the City of Marion does have a few small pockets of low pressure sewer systems. However, these proposed collection system improvements are all within areas of existing gravity sewer and are therefore best replaced with new, PVC, conventional gravity sewer or slip lined with cast-in-place-pipe (CIPP).

Selected Alternative

Based on the existing state of the areas identified and the familiarity with conventional gravity sewer systems, this alternative is recommended for the rehabilitation and replacement of the collection system areas identified.

C. Wastewater Treatment Alternatives

Chapters 3 and 4 presented an evaluation of the existing wastewater treatment facilities, and a projection of future wastewater flows and loads in the planning area. The existing facilities were shown to be incapable of meeting existing flows on a reliable basis and, therefore, cannot accommodate the I/I present in the system or any new growth.

Many options were discussed including pumping to a nearby system, installing decentralized treatment units in specified watersheds, and installing land applied treatment or septic system treatment. Since the City of Marion is the only public sewer system in the County, no nearby systems are feasible to pump to. Also, Marion has a very dense population being that the city isn't much larger than one square mile, and about half of the current wastewater flow is by gravity to the existing WWTP. This makes a conventional, public sewer system the only feasible option.

The following sections discuss alternatives for providing wastewater treatment capacity for the Marion planning area. It is the intent that all of the alternatives will provide a regional solution to wastewater treatment by sewering existing, unsewered areas; eliminate the need for small package plants that may arise in the area; and serve new development if needed.

Future Effluent Requirements

Effluent limits were defined by the Kentucky Department of Environmental Protection (KDEP) for the new Marion Wastewater Treatment Plant (WWTP), assuming an ADF rated capacity of 1.50 MGD and discharge to Rush Branch in a new location approximately 1,500 feet downstream of the existing KPDES discharge point. The 1.5 MGD Marion WWTP effluent requirements are shown in Table 8-2.

Table 8-2
Marion WWTP Site – 1.5 MGD Effluent Requirements

Parameter	May 1 – October 31	November 1 – April 30
Average Daily Flow	1.5 MGD	1.5 MGD
$CBOD_5$	20 mg/L	20 mg/L

Suspended Solids	30 mg/L	30 mg/L
Ammonia Nitrogen	4 mg/L	8 mg/L
Dissolved Oxygen	7 mg/L	7 mg/L
Total Phosphorus	1 mg/L	1 mg/L
Total Nitrogen	Monitor, mg/L	Monitor, mg/L
Total Residual Chlorine	0.011 mg/L	0.011 mg/L
Reliability Classification	Grade C	Grade C

The Wasteload allocation letter (WLA) from DOW is included in *Appendix M.*

D. Identification of Potential Treatment Alternatives

A "No Action" alternative, plus three expansion alternatives, were identified for the Marion WWTP. All of the new WWTP alternatives would provide a 1.5 MGD average day flow capacity and would utilize biological nutrient removal (BNR) and Enhanced Biological Phosphorus Removal (EBPR) and backup chemical phosphorus removal to meet nutrient limits. All alternatives would utilized sludge dewatering and landfill disposal. The treatment alternatives chosen are:

1. Sequencing Batch Reactor

2. Oxidation Ditches

3. Continuously Sequencing Reactors

Table 8-3 summarizes the above alternatives for the Marion WWTP. More detailed descriptions are provided below.

Table 8-3
1.5 MGD Process Alternatives

Alternative		Location	Wastewater Treatment Processes	Solids Treatment Processes/Disposal Method
1	Sequencing Batch Reactor (SBR)	New WWTP Site	Construct new biological nutrient removal (BNR) SBR system, and chemical phosphorus removal backup facilities.	Gravity sludge thickening, mechanical dewatering, conveying, and landfill disposal.
2	Oxidation Ditches (OD)	New WWTP Site	Construct new BNR OD system and chemical phosphorus removal backup facilities.	Same as Alternative 1
3	Continuously Sequencing Reactors (CSR)	New WWTP Site	Construct new BNR CSR system and chemical phosphorus removal backup facilities.	Same as Alternative 1

No Action Alternative

This alternative involves no initial construction, and no action other than maintaining and operating existing facilities. The objective of the option is to incur no additional capital cost associated with the WWTP.

As noted in *Chapter 6 - Existing Wastewater System*, many of the unit processes in the existing WWTP are undersized and cannot handle the wastewater system's hydraulic peaks. Also, many of the unit processes are very aged and well past their useful life. This alternative would result in regular violations of the KPDES permit, and could result in the degradation of groundwater and surface water within the planning area. Given the recent engagement of an Agreed Order between the City of Marion and the Department of Enforcement and given the consideration of the above, the "No Action" alternative is determined to be impractical, and will not be evaluated further.

Common Processes to Alternatives 1-3:

1. Rehab of the existing influent pump station at the existing WWTP site with a dedicated 10-inch force main to the new headworks.
2. Construction of a new wet weather pump station at the existing WWTP site with a dedicated 12-inch force main to the new headworks.
3. New headworks at the new WWTP site consisting of two (2) mechanical bar screens, influent splitter box.
4. **Process Alternatives (1, 2, or 3)**
5. Effluent splitter box with two (2) parallel mode clarifiers and one (1) series/parallel clarifier. (Alternative 2 and 3 only).
6. RAS/WAS pump station (Alternative 2 and 3 only).
7. UV Disinfection preceded by Peracetic Acid (PAA) pre-disinfection system.
8. Effluent flow measurement channel.
9. Cascade aeration to KPDES discharge.
10. One (1) Gravity sludge thickener.
11. Sludge feed pumps with dewatering fan press.

Alternative 1 – Sequencing Batch Reactor, New WWTP Site

In this alternative, two SBRs would be constructed with a third and fourth basins for flow equalization (EQ) and future growth.

Advantages:

-Can operate in storm flow mode to minimize solids loss.

-Eliminates the need for external clarifiers and RAS pumping which decreases construction costs.
-Automated operation.
-Square-wall construction decreases construction costs.
-Small construction footprint

Disadvantages:
-Operators are not familiar with the process.
-Requires the greatest understanding of process biology.
-Can be susceptible to filamentous growth if not properly operated.
-Requires influent and effluent flow EQ in most cases.
-Requires diffuser maintenance.

Alternative 2 – Oxidation Ditch, New WWTP Site

Advantages:
-High process reliability.
-Operational flexibility and simple operation.
-Can operate in storm flow mode to minimize solids loss.
-Designed with BNR capability.
-Common in Kentucky, operator familiarity.

Disadvantages:
-Higher construction costs.
-Higher energy costs.
-Requires separate clarifiers and RAS/WAS pumping.
-Larger footprint.

Alternative 3 – Continuously Sequencing Reactor, New WWTP Site

Advantages:
-Can operate in storm flow mode to minimize solids loss.
-Designed with BNR capability.
-Automated operation.
-Medium footprint.
-Low energy costs.

Disadvantages:
-Requires separate clarifiers and RAS/WAS pumping.
-Requires diffuser maintenance and wheel maintenance.

E. Analyses of Principal Alternatives

Present Worth Analysis

Present worth analyses, which represent the total life-cycle expenditure in terms of current dollar amounts, provide an equitable method of comparing the cost of various alternatives. This section includes present worth cost analyses for the treatment systems.

The present worth analysis includes capital costs; annual operations, maintenance and replacement (O,M&R) costs; and salvage values. Capital cost estimates, which include construction of improvements, miscellaneous construction items, and contractor's overhead and profit, were developed based on equipment prices from suppliers and bid tabulations from similar, recent construction projects.

Annual O,M&R cost includes staffing, utilities, maintenance, equipment repairs and replacement, consumables, and administration. Salvage values are calculated on a straight-line depreciation over the 20-year planning period. Tables 8-4 through 8-6 provide opinions of probable construction costs and project cost for the alternatives. These costs include all electrical, SCADA, and any miscellaneous costs for complete construction (as-bid estimates). Table 8-7 summarizes estimated operation, maintenance and replacement costs for all of the alternatives. Present worth analysis summaries for the wastewater treatment alternatives, based on a 20-year planning period and an interest rate of 2.0 percent, are provided in Table 8-8.

Table 8-4

Opinion of Probable Cost

Alternative 1 – Sequencing Batch Reactor at New WWTP Site

Item	Capital Cost, $	Service Life (Years)	20-Year Salvage Value, $
Site/Civil	400,000	40	200,000
Influent Pump Station Rehab and Wet Weather PS w/FM's	1,000,000	20	--
Headworks – Screening, Flow Measurement	600,000	20	--
Influent Splitter Box	50,000	40	25,000
SBR Equipment, Basins	1,000,000	40	500,000
PD Blowers / Electrical Building / Chem. Feed Storage	1,500,000	20	--
WAS Pump Station	150,000	20	--
PAA Equipment / Contact Basin	200,000	40	100,000
UV Disinfection System	400,000	20	--
Effluent Channel / Parshall Flume / Re-aeration Ladder	400,000	40	200,000
Gravity Thickener	300,000	40	150,000
Solids Dewatering / Building / Administration	1,500,000	20	--
Site Piping	800,000	40	400,000
Miscellaneous Metals / Valves / Gates	500,000	30	167,000
SCADA	200,000	20	--
Subtotal Construction Cost	$9,000,000		
Construction Contingency 10%	$900,000		
Project Development Costs	$1,300,000		
Total Opinion of Probable Cost/Salvage Value	$11,200,000		**$1,742,000**

Table 8-5

Opinion of Probable Cost

Alternative 2 – Oxidation Ditches at New WWTP Site

Item	Capital Cost, $	Service Life (Years)	20-Year Salvage Value, $
Site/Civil	400,000	40	200,000
Influent Pump Station Rehab and Wet Weather PS w/FM's	1,000,000	20	--
Headworks – Screening, Flow Measurement	600,000	20	--
Influent Splitter Box	50,000	40	25,000
OD Equipment / Basins	800,000	40	400,000
Effluent Splitter Box	50,000	40	25,000
Secondary Clarifier Equipment / Basins	900,000	40	450,000
Electrical Building / Chem. Feed Storage	1,000,000	20	--
RAS/WAS Pump Station	200,000	20	--
PAA Equipment / Contact Basin	200,000	40	100,000
UV Disinfection System	400,000	20	--
Effluent Channel / Parshall Flume / Re-aeration Ladder	400,000	40	200,000
Gravity Thickener	300,000	40	150,000
Solids Dewatering Building / Electrical / Administration	1,500,000	20	--
Site Piping	800,000	40	400,000
Miscellaneous Metals / Valves / Gates	500,000	30	167,000
SCADA	200,000	20	--
Subtotal Construction Cost	$9,300,000		
Construction Contingency 10%	$930,000		
Project Development Costs	$1,300,000		
Total Opinion of Probable Cost/Salvage Value	$11,530,000		**$2,117,000**

Table 8-6

Opinion of Probable Cost

Alternative 3 – Continuously Sequencing Reactor at New WWTP Site

Item	Capital Cost, $	Service Life (Years)	20-Year Salvage Value, $
Site/Civil	400,000	40	200,000
Influent Pump Station Rehab and Wet Weather PS w/FM's	1,000,000	20	--
Headworks – Screening, Flow Measurement	600,000	20	--
Influent Splitter Box	50,000	40	25,000
CSR Equipment, Basins	500,000	40	250,000
Effluent Splitter Box	50,000	40	25,000
Secondary Clarifier Equipment / Basins	900,000	40	450,000
PD Blowers / Electrical Building / Chem. Feed Storage	1,000,000	20	--
RAS/WAS Pump Station	200,000	20	--
PAA Equipment / Contact Basin	200,000	40	100,000
UV Disinfection System	400,000	20	--
Effluent Channel / Parshall Flume / Re-aeration Ladder	400,000	40	200,000
Gravity Thickener	300,000	40	150,000
Solids Dewatering / Building / Administration	1,500,000	20	--
Site Piping	800,000	40	400,000
Miscellaneous Metals / Valves / Gates	500,000	30	167,000
SCADA	200,000	20	--
Subtotal Construction Cost	$9,000,000		
Construction Contingency 10%	$900,000		
Project Development Costs	$1,300,000		
Total Opinion of Probable Cost/Salvage Value	$11,200,000		**$1,967,000**

Table 8-7

Average Annual Wastewater Treatment O,M&R[1] Costs[2]

Alternative		Power	Chemical	Equipment /Materials	Staffing	Sludge Disposal	Total O,M&R
1	Sequencing Batch Reactor	$90,000	$3,000	$50,000	$80,000	$30,000	$253,000
2	Oxidation Ditch	$120,000	$3,000	$40,000	$80,000	$30,000	$273,000
3	Continuously Sequencing Reactor	$90,000	$3,000	$50,000	$80,000	$30,000	$253,000

Notes: [1]O,M&R – Operation, maintenance and replacement for entire wwtp
[2]All costs based on average flow of 1.0 MGD over 20-year period

Table 8-8
Wastewater Treatment Alternatives Opinions of Probable Costs and Present Worth[1]

Alternative		Construction Cost[2]	Project Cost[5]	Annual O,M&R[3]	Salvage Value	Total Present Worth[4]
1	Sequencing Batch Reactor	$9,900,000	$11,200,000	$253,000	$1,742,000	$12,864,437
2	Oxidation Ditch	$10,230,000	$11,530,000	$273,000	$2,117,000	$13,269,082
3	Continuously Sequencing Reactor	$9,900,000	$11,200,000	$253,000	$1,967,000	$12,713,012

Notes:
[1]All costs in 2017 dollars.
[2]Costs include mobilization, demobilization, general conditions, contractor's overhead and profit, and contingency.
[3]O,M&R = Operation, maintenance, and replacement.
[4]Present worth = [Construction cost + (16.351 x O,M&R cost)] – (0.6730 x salvage value). Factors 20 years and 2.0 percent interest.
[5]Includes total project development for wwtp but not collection system project development costs.

Non – Economic Analysis

The present worth comparison is limited when used to evaluate alternatives because only the construction costs, O,M,&R costs, and salvage values are considered. Other factors not directly related to these costs are included in the evaluation to determine the true effectiveness of an alternative. Evaluation criteria, both economic and non-economic, used to rank the wastewater treatment alternatives are as follows:

- Environmental Impact – short and long term impacts on the environment.
- Public Acceptance – a measure of public acceptance of the project.
- Flexibility – ability to adapt to changing conditions.
- Reliability – a measure of performance dependability.
- Operability – ease of operation.
- Energy Use – energy conservation.
- Constructability – ease with which the alternative can be constructed and phased into operation.

These evaluation criteria were used to provide a quantitative score for each of the alternatives. The score for any particular alternative is determined by using an analysis matrix. Anticipated performance of a particular alternative and the relative importance of specific evaluation criteria is considered by assigning a numerical value to each alternative. A ranking of one to five was selected based on anticipated success of the alternative relative to the specific evaluation criteria. One represents the least favorable ranking, and five represents the most favorable ranking. The seven evaluation criteria were assigned a weight factor based on relative importance. A total of 100 points was distributed among the seven criteria for a maximum score

of 500. A score for each wastewater treatment alternative was calculated by multiplying the weight factor by the ranking.

Table 8-9 presents the non-economic effectiveness analysis for the wastewater treatment alternatives. This analysis provides a numerical comparison of different alternatives including both economic and non-economic performance factors. Alternative 3, Continuously Sequencing Reactor, scored highest in the non-economic analysis. This is due primarily to the high flexibility, ease of operation of the treatment processes, and the advantages associated with lower construction and energy costs. The second highest scoring alternative was Alternative 1, followed by Alternative 2.

Table 8-10 presents a comparison of the present worth and the non-economic effectiveness of each alternative. This comparison is derived by dividing the present worth by the non-economic effectiveness total for each alternative.

Table 8-9
Non-Economic Effectiveness Analysis for Treatment Alternatives

Evaluation Criteria	Weight Factor	Alternative 1 - Sequencing Batch Reactor		Alternative 2 - Oxidation Ditches		Alternative 3 - Continuously Sequencing Reactor	
		Raw Score	Weight Score	Raw Score	Weight Score	Raw Score	Weight Score
Environmental Impact	10	4	40	3	30	4	40
Public Acceptance	10	4	40	4	40	4	40
Flexibility	15	5	65	3	45	5	75
Reliability	15	3	45	5	75	3	45
Operability	15	3	45	5	75	4	60
Energy Use	20	4	80	3	60	4	80
Constructability	15	5	75	3	45	4	60
Total Weight Score	**100**	**390**		**370**		**400**	

Note: [1]Raw score based on a range from one to five with five being superior and one being poor.

Table 8-10
Wastewater Treatment Economic/Non-Economic Effectiveness Comparison

Alternative		Construction Cost	Total Project Cost[1]	Present Worth	Non-Economic Effectiveness	PW/NE Ratio
1	Sequencing Batch Reactor	$9,900,000	$11,200,000	$12,864,437	390	32,986
2	Oxidation Ditch	$10,230,000	$11,530,000	$13,269,082	370	35,862
3	**Continuously Sequencing Reactor**	**$9,900,000**	**$11,200,000**	**$12,713,012**	**400**	**31,783**

Notes: [1]Total project cost equals construction cost plus project development cost
[2]Recommended alternative is in **bold**

From this table, the selected alternative is recommended.

F. Selected Alternative

Alternative 3, which consists of a continuously sequencing reactor system to be constructed at the new WWTP site with backup chemical phosphorus removal, has the lowest present worth cost and achieved the highest non-economic effectiveness score of the alternatives. These factors combine to give it the highest score in the overall economic/non-economic evaluation. Alternative 3 is, therefore, the recommend alternative.

Process reliability for each process will be addressed during the design stage. As stated in Table 8-2, the reliability classification is a Grade C as per 401 KAR5:005, Section 13. The proposed alternate power source to provide continuous use of the influent pumping, screening, and disinfection unit processes will be standby power generators. Based on design flow and loading, the necessary unit processes will have redundancy.

Table 8-11 provides design data for the major components of the proposed Marion WWTP. The Reliability and Redundancy Requirements form is included in *Appendix N.*

Table 8-11

Selected WWTP Alternative Design Criteria

Alternative 3 – Continuously Sequencing Reactor, New WWTP Site

1. Design Flow, MGD	1.5
- Peak flow rate, MGD	6.0
- Five-day biochemical oxygen demand, mg/L and lbs/day	200 and 2,502
- Total suspended solids, mg/L and lbs/day	300 and 3,753
- Ammonia nitrogen, mg/L and lbs/day	20 and 250
- Total phosphorus, mg/L and lbs/day	8 and 100
2. Influent Pumps	
- Duty Number of units	2
- Capacity, each, GPM	1,000 @ 75ft TDH
- Type	Variable speed submersible/chopper
- Horsepower, each	20
- Wet Weather Number of units	3
- Capacity, each, GPM	1,600 @ 75ft TDH
- Type	Variable speed submersible
- Horsepower, each	35
3. Screening	
- Number of units	2 mechanical bar screens
- Capacity, MGD each	6.0
- Size opening, inches	0.25
- Motor, horsepower	1.5
- Speed, feet per minute	10
4. Extended Aeration (Continuously Sequencing Reactor)	
- Number of tanks	2
- Diameter, feet	60
- Average water depth, feet	16
- Total volume, gallons	700,000
- Retention time, hours	11.2 @ 1.5 MGD
- Aeration type	Fine Bubble Diffusers
- Number of aerators per basin	1
- PD Blower	2
- PD Blower horsepower, each	20
- MLSS, mg/L	4,000
- Solids, retention time, days	60
5. Clarifiers	
- Number of tanks	3
Diameter, feet	62
Sidewater depth, feet	15
Volume, gallons (each)	338,700
Type	Center feed
Effluent weir length (2 units), feet	390
Surface area (2 units), feet^2	5,899
- Surface overflow rate (2 units), Qp GPD/feet^2	248 @ 1.5 MGD, 992 @ 6.0 MGD
- Weir loading rate (2 units), GPD/feet	3,851 @ 1.5 MGD, 15,402 @ 6.0 MGD
- Solids loading rate design (2 units), lbs/feet^2-day	22
6. Ultraviolet Disinfection	
- TSS (assumed), mg/L	30
- Fecal coliform count (effluent)	< 200 per ml
- UV transmission (minimum)	65 percent
- Number of UV banks	2
- Number of UV modules per bank	7
- Number of UV lamps per module	8
7. Post Aeration (Cascade)	
- Vertical Drop, feet	30
8. Return Sludge Pumps	
- Number of units	2 (1 standby)
- Max Capacity, each, GPM	1,500 @ 50ft TDH
- Type	Variable Speed Submersible
- Horsepower, each	20

9. Gravity Sludge Thickening	
- Number of tanks	1
- Diameter, feet	30
- Sidewater depth, feet	12
- Weir length, feet	90
10. Thickened Waste Sludge Pumps	
- Number of units	2 (1 standby)
- Capacity, GPM	80 @ 20ft TDH
- Type	Rotary Lobe
- Horsepower, each	5
11. Backup Chemical Feed for Phosphorus Removal	
- Alum, mg/L and lbs/day	75 and 938
- Polymer, mg/L and lbs/day	1 and 13

Note: All design criteria and equipment/facility sizing to be verified during design.

City Of Marion, Kentucky
WWTP - Alternate 1

SBR - Sequencing Batch Reactor
PAA - Peracetic Acid Treatment
RAS - Return Activated Sludge
WAS - Waste Activated Sludge

N.T.S.

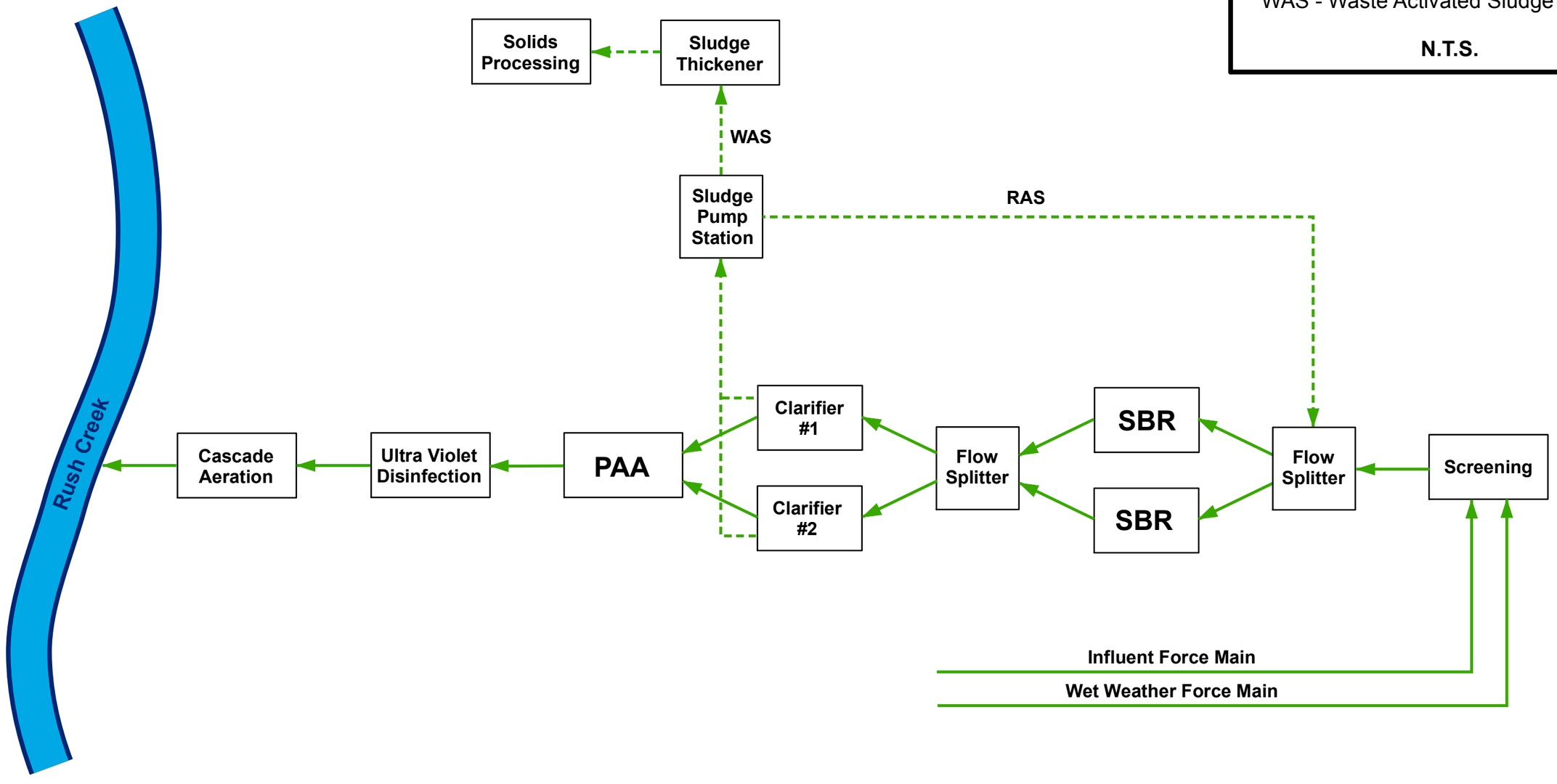

FIGURE 8-1

ECLIPSE ENGINEERS, PLLC
113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959

City Of Marion, Kentucky
WWTP - Alternate 2

PAA - Peracetic Acid Treatment
RAS - Return Activated Sludge
WAS - Waste Activated Sludge

N.T.S.

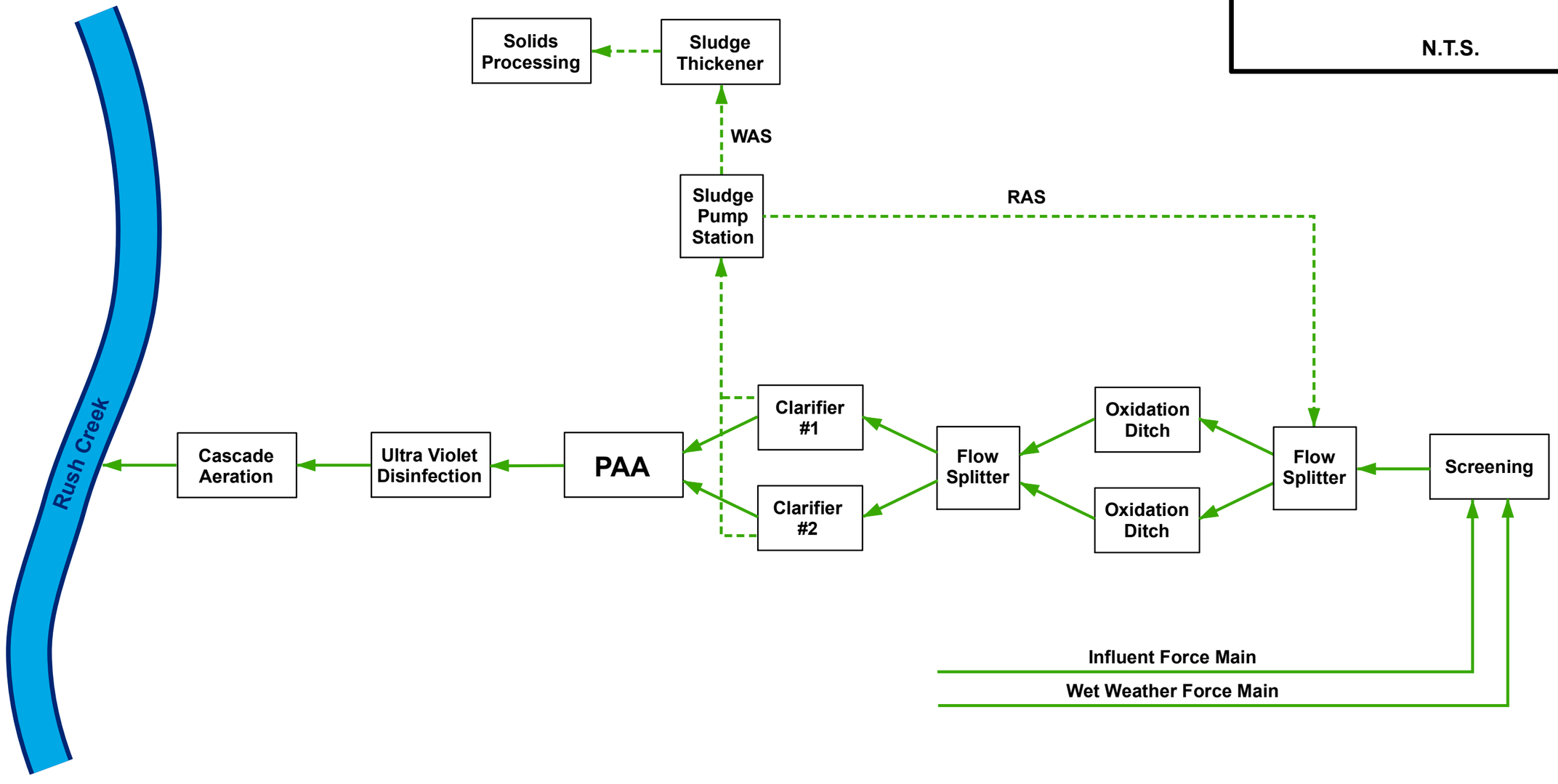

FIGURE 8-2

ECLIPSE ENGINEERS, PLLC
113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959

City Of Marion, Kentucky
WWTP - Alternate 3

CSR - Continuously Sequencing Reactor
PAA - Peracetic Acid Treatment
RAS - Return Activated Sludge
WAS - Waste Activated Sludge

N.T.S.

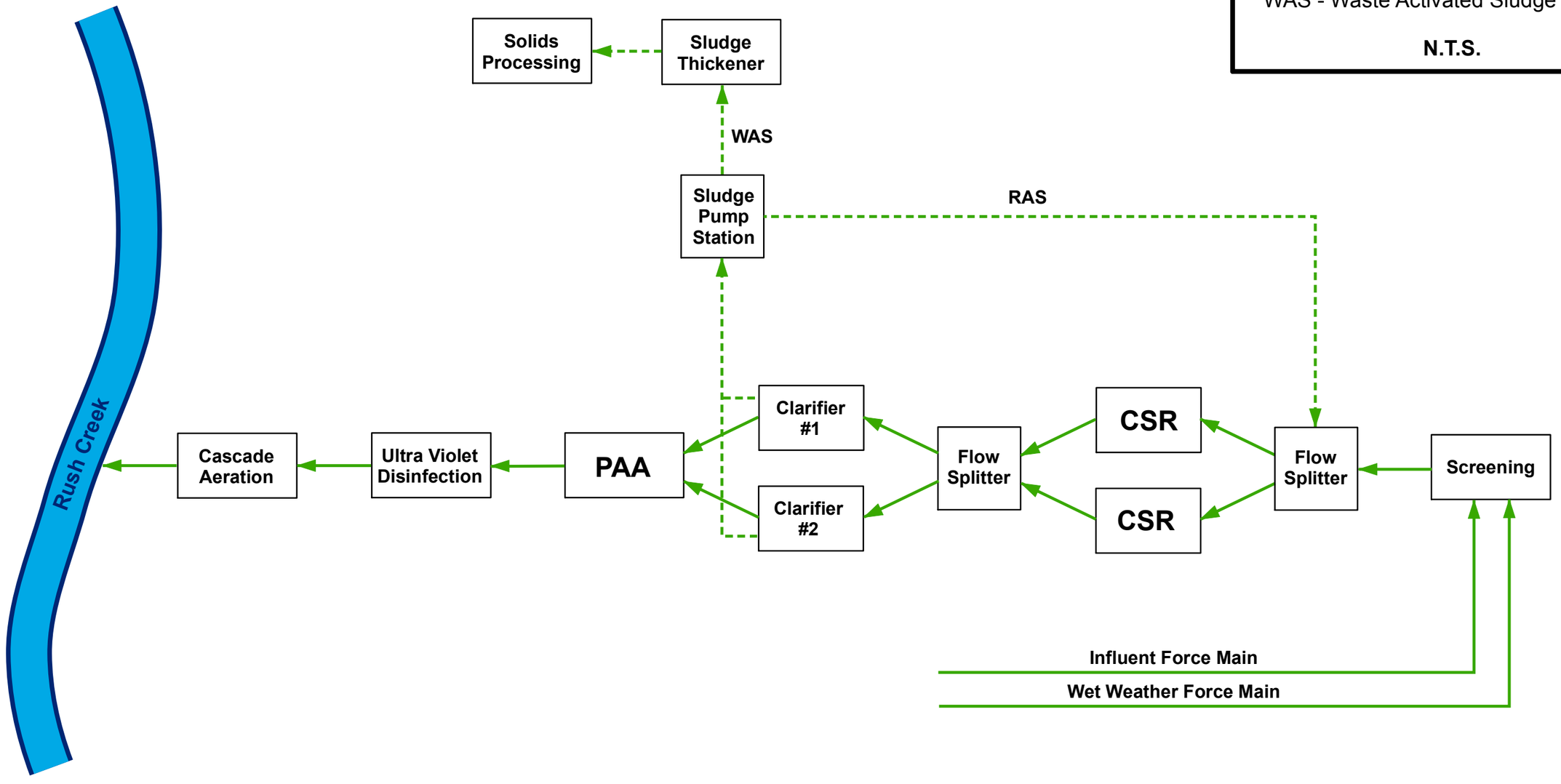

FIGURE 8-3

ECLIPSE ENGINEERS, PLLC
113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959

Section 9 – Cross-Cutter Correspondence and Mitigation

The purpose of this chapter is to show the correspondence between the City and the cross-cutter agencies contacted for the project. Included in this chapter are contact letters and responses from the following agencies:

- U.S. Fish and Wildlife Service
- Kentucky Department of Fish and Wildlife Resources
- Kentucky Heritage Council
- U.S. Army Corp of Engineers
- Natural Resources and Conservation Service

CITY OF MARION

217 South Main Street • Marion, Kentucky 42064
www.marionky.gov

Telephone
(270) 965-2266

Fax
(270) 965-5235

TDD
(270) 965-3500

October 9, 2017

Ms. Lori Dials
Environmental Scientist
Water Infrastructure Branch
Kentucky Division of Water
300 Sower Boulevard, 3rd Floor
Frankfort, Kentucky 40601

Re: Wastewater System Facilities Plan
Cross-Cutter Agencies Letter of Commitment
City of Marion
Marion, Kentucky

Ms. Dials:

The City of Marion has reviewed the response letters from the cross-cutter agencies related to the environmental impact with our project. The City intends to follow the direction of these agencies per the response letters received from USFWS, KDFWR, KHC, USACE, and NRCS at this time.

Sincerely,

Adam Ledford
City Administrator

Exhibit 9-1
U.S. Fish and Wildlife Service Correspondence

ECLIPSE
ENGINEERS, PLLC

July 28, 2017

Mr. Lee Andrews
Field Supervisor
U.S. Fish and Wildlife Service
330 W. Broadway, Rm. 265
Frankfort, Kentucky 40601

Re: Wastewater Treatment Plant
City of Marion
Marion, Kentucky

Mr. Andrews:

Eclipse Engineers has been retained by the City of Marion to prepare a Regional Facilities Plan for a proposed wastewater treatment plant (WWTP) in Crittenden County, Kentucky. The City is in the process of obtaining funding for the project. The WWTP will be constructed in one phase with an estimated construction cost of $9.9 million.

The project will consist of a 1.5 million gallon per day (MGD) WWTP replacing the aged existing plant. The WWTP will be located in the existing Industrial Park - North just inside the northern end of the city limits along the newly constructed Pippi Hardin Boulevard.

The system will treat all of the current 1,500 residential, commercial, and industrial sewer customers. An Environmental Assessment is currently being completed by the Pennyrile Area Development District (PeADD). As part of the Facilities Plan, we are requesting that the USFWS provide us with updated information concerning the possibility of ecologically sensitive areas, or federally listed endangered or threatened species.

Please submit comments in a letter addressed to the undersigned when you have completed your review. Attached is a copy of the WWTP Location Map.

If you need any additional information or have any comments do not hesitate to call me at (606) 451-0959 or (859) 433-9585 or email arobinson@eclipseengineers.net.

Sincerely,
Eclipse Engineers, PLLC

Alan R. Robinson, P.E.
President

113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959
www.eclipseengineers.net

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

June 12, 2017

Dear Project Proponent:

We have received your request for a species list for your project. The Kentucky Field Office (KFO) is directing project proponents to obtain species lists from the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) system located at: https://ecos.fws.gov/ipac/. IPaC will immediately provide you with a current species list appropriate for your proposed project and an official letter on USFWS letterhead. This list will include species currently listed as threatened or endangered, species proposed for listing, critical habitat for listed species, and bird species of conservation concern.

When you open the IPaC site, you will be asked to input a location for your proposed project. The location can be input in different ways. Often, the easiest way is to zoom into the vicinity of the project area on the map and use the sketch tool to approximate the boundaries of the proposed project site, plus an appropriate buffer. This location that you input should represent the entire "action area" of your proposed project by considering all the potential "effects of the action," including potential direct, indirect, and cumulative effects to federally-listed species or their critical habitat as defined in 50 CFR 402.02. This includes effects of any "interrelated actions" that are part of a larger action and depend on the larger action for their justification and "interdependent actions" that have no independent utility apart from the action under consideration (e.g.; utilities, access roads, etc.) and future actions that are reasonably certain to occur as a result of the proposed project (e.g.; development in response to a new road).

IPaC will generate a species list specific to the action area of the proposed project, as you defined it. You can then request an official species list under the "Regulatory Documents" tab. This species list fulfills the requirements of the USFWS under section 7(c) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.) to provide information as to whether any proposed or listed species may be present in the area of a proposed action. The letter generated by IPaC will explain how to request an updated list or a revised list based on project modifications.

The official species list is not a concurrence letter; additional coordination with the KFO may be necessary to ensure ESA compliance. Please read the letter that accompanies the species list for further direction as to how to request technical assistance or section 7 consultation from the KFO. Please include the consultation tracking number on the IPaC-generated letter (e.g., 04EK1000-####-SLI-####) at the top of your future correspondences with the KFO. The KFO

will be able to retrieve the information that you input into IPaC; there is no need to include a printed copy of your IPaC-generated letter or species list with your correspondence.

Thank you for your request. Your concern for the protection of endangered and threatened species is greatly appreciated. If you have any questions or problems obtaining a species list from IPaC, please contact Jessica Blackwood Miller at (502) 695-0468 extension 104 or jessica_miller@fws.gov.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

SITE PLAN

SCALE 1"=400'

FIGURE 6-3

MARION WASTEWATER TREATMENT PLANT
CITY OF MARION
217 S. MAIN STREET
MARION, KENTUCKY 42064

ECLIPSE ENGINEERS, PLLC
113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959

Exhibit 9-2
KY Dept. of Fish and Wildlife Res. Correspondence

ECLIPSE
ENGINEERS, PLLC

July 28, 2017

Mr. Daniel Stoelb
Biologist, Environmental Section
Kentucky Department of Fish and Wildlife Resources
1 Sportsman Lane
Frankfort, Kentucky 40601

Re: Wastewater Treatment Plant
City of Marion
Marion, Kentucky

Mr. Stoelb:

Eclipse Engineers has been retained by the City of Marion to prepare a Regional Facilities Plan for a proposed wastewater treatment plant (WWTP) in Crittenden County, Kentucky. The City is in the process of obtaining funding for the project. The WWTP will be constructed in one phase with an estimated construction cost of $9.9 million.

The project will consist of a 1.5 million gallon per day (MGD) WWTP replacing the aged existing plant. The WWTP will be located in the existing Industrial Park - North just inside the northern end of the city limits along the newly constructed Pippi Hardin Boulevard.

The system will treat all of the current 1,500 residential, commercial, and industrial sewer customers. An Environmental Assessment is currently being completed by the Pennyrile Area Development District (PeADD). As part of the Facilities Plan, we are requesting that the KDFWR provide us with updated information concerning the possibility of state listed or federally listed endangered or threatened species.

Please submit comments in a letter addressed to the undersigned when you have completed your review. Attached is a copy of the WWTP Location Map.

If you need any additional information or have any comments do not hesitate to call me at (606) 451-0959 or (859) 433-9585 or email arobinson@eclipseengineers.net.

Sincerely,
Eclipse Engineers, PLLC

Alan R. Robinson, P.E.
President

113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959
www.eclipseengineers.net

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY DEPARTMENT OF FISH & WILDLIFE RESOURCES

Matthew G. Bevin
Governor

Don Parkinson
Secretary

#1 Sportsman's Lane
Frankfort, Kentucky 40601
Phone (502) 564-3400
1-800-858-1549
Fax (502) 564-0506
fw.ky.gov

Regina Stivers
Deputy Secretary

Gregory K. Johnson
Commissioner

4 August 2017

Eclipse Engineers, PLLC
Attn: Alan R. Robinson
113 West Mt. Vernon Street
Somerset, Kentucky 42501

RE: Wastewater Treatment Plant
City of Marion
Marion, Kentucky

Dear Mr. Robinson:

The Kentucky Department of Fish and Wildlife Resources (KDFWR) has received your request for information pertaining to the subject project. The Kentucky Fish and Wildlife Information System indicates the federally - listed Grey bat *(Myotis grisescens)* and Northern Long-eared bat *(Myotis septentrionalis)* are known to occur within 10 miles of the project site. No additional state-listed species are known to occur within one mile of the project site. Please be aware that our database is a dynamic one that only represents our current knowledge of various species distributions.

No caves, critical habitats, trout streams/fish spawning areas, or any other unique natural areas are known to occur within close proximity to the project site. To minimize indirect impacts to the aquatic environment, the KDFWR recommends that erosion control measures be developed and implemented prior to construction to reduce siltation into waterways located within the project area. Such erosion control measures may include, but are not limited to silt fences, staked straw bales, brush barriers, sediment basins, and diversion ditches. Erosion control measures will need to be installed prior to construction and should be inspected and repaired regularly as needed.

I hope this information is helpful to you, and if you have questions or require additional information, please call me at (502) 564-7109 extension 4453.

Sincerely,

Dan Stoelb
Environmental Scientist

Cc: Environmental Section File

Exhibit 9-3
Kentucky Heritage Council Correspondence

ECLIPSE
ENGINEERS, PLLC

July 28, 2017

Ms. Donna M. Neary
State Historic Preservation Officer
Kentucky Heritage Council
300 Washington Street
Frankfort, Kentucky 40601

Re: Wastewater Treatment Plant
City of Marion
Marion, Kentucky

Ms. Neary:

Eclipse Engineers has been retained by the City of Marion to prepare a Regional Facilities Plan for a proposed wastewater treatment plant (WWTP) in Crittenden County, Kentucky. The City is in the process of obtaining funding for the project. The WWTP will be constructed in one phase with an estimated construction cost of $9.9 million.

The project will consist of a 1.5 million gallon per day (MGD) WWTP replacing the aged existing plant. The WWTP will be located in the existing Industrial Park - North just inside the northern end of the city limits along the newly constructed Pippi Hardin Boulevard.

The system will treat all of the current 1,500 residential, commercial, and industrial sewer customers. As part of the Facilities Plan, we are requesting that the KHC provide us with an opinion of the attached Surveys regarding information concerning any historic and/or archeological resources on and adjacent to the proposed site.

Please submit comments in a letter addressed to the undersigned when you have completed your review. Attached is a complete copy of the *Cultural Historic Survey* and *Cultural Resource Survey* as prepared by Cultural Resource Analysts.

If you need any additional information or have any comments do not hesitate to call me at (606) 451-0959 or (859) 433-9585 or email arobinson@eclipseengineers.net.

Sincerely,
Eclipse Engineers, PLLC

Alan R. Robinson, P.E.
President

113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959
www.eclipseengineers.net

MATTHEW G. BEVIN
GOVERNOR

DON PARKINSON
SECRETARY

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL
THE STATE HISTORIC PRESERVATION OFFICE
THE BARSTOW HOUSE
410 HIGH STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
FAX (502) 564-5820
www.heritage.ky.gov

REGINA STIVERS
DEPUTY SECRETARY

CRAIG A. POTTS
EXECUTIVE DIRECTOR
& STATE HISTORIC
PRESERVATION OFFICER

August 11, 2017

Mr. Alan R. Robinson
President
Eclipse Engineers, PLLC
113 West Mt. Vernon Street
Somerset, Kentucky 42501

RE: A Cultural Resource Survey for the Proposed Marion Wastewater Treatment Plant Project in Crittenden County, Kentucky by Joseph R. Miller of Cultural Resource Analysts, Inc., Evansville, Indiana

Dear Mr. Robinson,

Thank you for your letter concerning the above-referenced report. This investigation of approximately 8.53 acres entailed visual ground surface inspection and the hand excavation of systematic, screened shovel test probes within the project area. During the survey, one previously unreported archaeological site (15Cn69) was documented. Site 15Cn69 is a temporally unassigned prehistoric open habitation without mounds, a sparse lithic scatter restricted to the disturbed context of the plow zone. Due to its lack of further research potential, the author assessed Site 15Cn69 to be ineligible for listing in the National Register of Historic Places (NRHP). As no cultural resources listed in or eligible for listing in the NRHP apparently exist within the project area, the author recommended no further archaeological work for the project.

We concur with the survey findings and with the recommendation made. We accept this report without revision.

We look forward to receipt of one (1) additional report copy for archival purposes. Should you have any questions, feel free to contact Nicolas Laracuente of my staff at 502.564.7005, extension 4566.

Sincerely,

Craig A. Potts,
Executive Director and
State Historic Preservation Officer

CP: KHC # 49744 - 4
Cc: George Crothers (OSA); Charles Niquette (CRAI)

MATTHEW G. BEVIN
GOVERNOR

DON PARKINSON
SECRETARY

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL
THE STATE HISTORIC PRESERVATION OFFICE
410 HIGH STREET
FRANKFORT, KENTUCKY 40601
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FAX (502) 564-5820
www.heritage.ky.gov

REGINA STIVERS
DEPUTY SECRETARY

CRAIG A. POTTS
EXECUTIVE DIRECTOR
& STATE HISTORIC
PRESERVATION OFFICER

September 11, 2017

Alan R. Robinson
Eclipse Engineers, PLLC
113 West Mt. Vernon Street
Somerset, KY 42501

Re: ABOVEGROUND RESPONSE ONLY: ***Cultural Historic Survey for the Proposed Marion Wastewater Treatment Plan Project in Crittenden County, Kentucky*** **by Holly Higgins, 3-9-17**

Dear Mr. Robinson:

Thank you for your letter and a copy of the above report. We understand from your letter that the City of Marion is preparing a Regional Facilities Plan for a proposed wastewater treatment plant in Crittenden County. We understand that the WWTP will be located in the existing Industrial Park – North just inside the northern end of the city limits along the newly constructed Pippi Hardin Boulevard. We understand from the author's report that no previously-surveyed properties were identified within the APE, but that Joseph Miller of CRA identified two previously-undocumented sites (CN-89, CN-90). We understand that the author recommended that neither of these two sites is eligible for inclusion in the NRHP and recommended a No historic Properties Affected finding for the project.

After our review of the report, we concur that CN-89 (Site 1) does not have sufficient integrity or significance to be listed on the NRHP and that it is Not Eligible for listing on the NRHP. We do feel; however, that CN-90 (Site 2) retains sufficient integrity as a 20th century farmstead to be significant under Criterion A within the theme of the agricultural development of Crittenden County. Although we recommend that CN-90 appears Eligible for listing in the NRHP; we can recommend a No Adverse Effect finding for the aboveground portion of this project only, as it does not appear that the project would diminish any of the qualities that make it significant. If you have any questions, or if project plans should change, please contact Jennifer Ryall of my staff at (502)564.7005, ext. 4565.

Sincerely,

Craig A. Potts,
Executive Director and State Historic Preservation Officer

CP: jr, KHC #49730

Exhibit 9-4
U.S. Army Corps of Engineers Correspondence

ECLIPSE
ENGINEERS, PLLC

July 28, 2017

United States Army Corps of Engineers
Louisville Regulatory District Office
RDS, Room 752
P.O. Box 59
Louisville, Kentucky 40201-0059

Re: Wastewater Treatment Plant
City of Marion
Marion, Kentucky

Dear Sir/Madam:

Eclipse Engineers has been retained by the City of Marion to prepare a Regional Facilities Plan for a proposed wastewater treatment plant (WWTP) in Crittenden County, Kentucky. The City is in the process of obtaining funding for the project. The WWTP will be constructed in one phase with an estimated construction cost of $9.9 million.

The project will consist of a 1.5 million gallon per day (MGD) WWTP replacing the aged existing plant. The WWTP will be located in the existing Industrial Park - North just inside the northern end of the city limits along the newly constructed Pippi Hardin Boulevard.

The system will treat all of the current 1,500 residential, commercial, and industrial sewer customers. An Environmental Assessment is currently being completed by the Pennyrile Area Development District (PeADD). As part of the Facilities Plan, we are requesting that the USACE provide us with updated information concerning the possibility of wetlands within the impact area. The project will not impact any streams other than Rush Creek as the new KPDES discharge is constructed near the east bank.

Please submit comments in a letter addressed to the undersigned when you have completed your review. Attached is a copy of the WWTP Location Map.

If you need any additional information or have any comments do not hesitate to call me at (606) 451-0959 or (859) 433-9585 or email arobinson@eclipseengineers.net.

Sincerely,
Eclipse Engineers, PLLC

Alan R. Robinson, P.E.
President

113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959
www.eclipseengineers.net

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059

REPLY TO
ATTENTION OF:

August 15, 2017

Regulatory Division
South Branch
ID No. LRL-2017-754-sea

Mr. Alan Robinson
Eclipse Engineers, PLLC
113 West Mt. Vernon Street
Somerset, Kentucky 42501

Dear Mr. Robinson:

This is in response to your letter received on July 31, 2017, requesting comments on behalf of the City of Marion, Crittenden County, Kentucky (Latitude: 37.34978 ° N; Longitude: 88.06822° W). The proposed action would include the construction of a new waste water treatment plant for the City of Marion.

The U.S. Army Corps of Engineers (USACE) exercises regulatory authority under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) and Section 404 of the Clean Water Act, 1972 (33 USC 1344) for certain activities in "waters of the United States (U.S.)." These waters include all waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce. "Waters of the U.S." include hydrologically connected lakes, rivers, and stream channels (perennial, intermittent, or ephemeral) exhibiting an Ordinary High Water Mark (OHWM), wetlands, sloughs, wet meadows and wetlands adjacent to "waters of the U.S."

If the project would necessitate the discharge of dredged or fill material into any "waters of the U.S.," then you should submit a Department of the Army (DA) permit application for review by this office. We will need a completed DA permit application along with additional details regarding the project's design, scope, photos, construction methods, purpose and a delineation of all "waters of the U.S.," including the coordinates and locations of each "water" within the proposed project area and all impacts to waters (linear feet and acreage). You are reminded that all drawings must be submitted on 8½ x 11-inch paper and be of reproducible quality.

Our lack of comments on specific potential environmental impacts should not be construed as concurrence that no significant environmental damage would result from the project. Our comments on this project are limited to only those effects which may fall within our area of jurisdiction and thus does not obviate the need to obtain other permits from State or local agencies.

Further information on the Regulatory Program, including the DA permit application, can be obtained from our website located at: http://www.lrl.usace.army.mil/Missions/Regulatory.aspx. Please allow sufficient time in your preconstruction schedule for the processing of a DA permit application.

If you have any questions concerning this matter, please contact this office at the above address, ATTN: CELRL-RDS or call me at (502) 315-6711. All correspondence pertaining to this matter should refer to our ID No. LRL-2017-754-sea.

Sincerely,

Sarah Atherton
Project Manager

Exhibit 9-5
Natural Res. and Conservation Serv. Correspondence

ECLIPSE
ENGINEERS, PLLC

July 28, 2017

Ms. Karen Woodrich
State Conservationist
Kentucky NRCS State Office
771 Corporate Drive
Suite 300
Lexington, Kentucky 40503

Re: Wastewater Treatment Plant
City of Marion
Marion, Kentucky

Ms. Woodrich:

Eclipse Engineers has been retained by the City of Marion to prepare a Regional Facilities Plan for a proposed wastewater treatment plant (WWTP) in Crittenden County, Kentucky. The City is in the process of obtaining funding for the project. The WWTP will be constructed in one phase with an estimated construction cost of $9.9 million.

The project will consist of a 1.5 million gallon per day (MGD) WWTP replacing the aged existing plant. The WWTP will be located in the existing Industrial Park - North just inside the northern end of the city limits along the newly constructed Pippi Hardin Boulevard.

The system will treat all of the current 1,500 residential, commercial, and industrial sewer customers. An Environmental Assessment is currently being completed by the Pennyrile Area Development District (PeADD). As part of the Facilities Plan, we are requesting that the NRCS provide us with updated information concerning ecosystem conservation as it applies to this project.

Please submit comments in a letter addressed to the undersigned when you have completed your review. Attached is a copy of the WWTP Location Map.

If you need any additional information or have any comments do not hesitate to call me at (606) 451-0959 or (859) 433-9585 or email arobinson@eclipseengineers.net.

Sincerely,
Eclipse Engineers, PLLC

Alan R. Robinson, P.E.
President

113 WEST MT. VERNON STREET
SOMERSET, KENTUCKY 42501
PHONE: 606-451-0959
www.eclipseengineers.net

RE: Marion WWTP

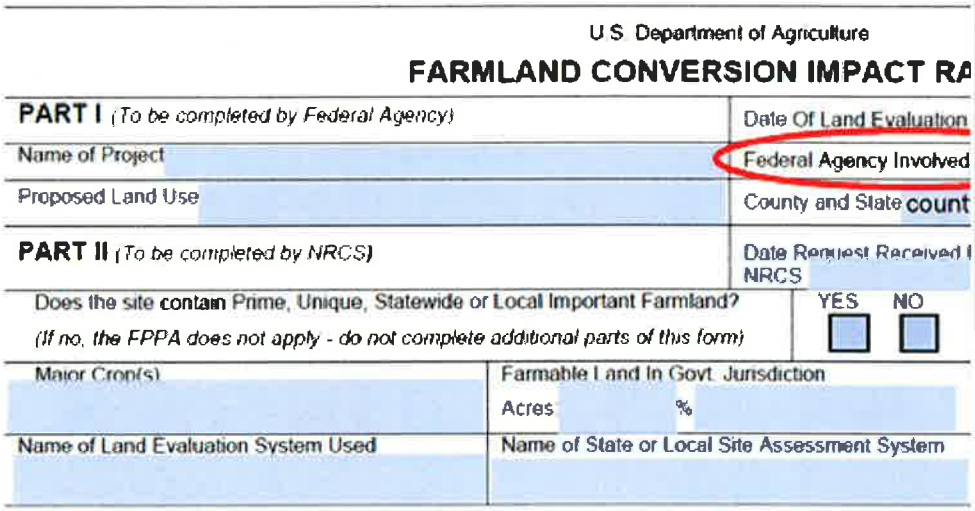
Message 1 of 2382

From **McIntosh, Jerry - NRCS, Mayfield, KY**
To **Alan Robinson**
Date **Today 11:33**

Thanks for the Reply Alan. Again, we (NRCS) do not comment on what appears to be something that falls within the realm of Environmental Assessment.

Usually, if federal dollars are being used DIRECTLY, this type of project is funded through USDA's Rural Development and they send me an AD-1006 *(see below)*. Sounds like it's possible Flow-thru federal monies might be involved via KIA, but not DIRECT federal dollars and, therefore, is not subject to Farmland Policy Protection Act (FPPA).

In essence, if a response is 'required' to satisfy DOW simply state NRCS had "NO REPSONSE".



U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RA

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation
Name of Project	Federal Agency Involved
Proposed Land Use	County and State count
PART II *(To be completed by NRCS)*	Date Request Received NRCS
Does the site contain Prime, Unique, Statewide or Local Important Farmland? *(If no, the FPPA does not apply - do not complete additional parts of this form)*	YES ☐ NO ☐
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres %
Name of Land Evaluation System Used	Name of State or Local Site Assessment System

Jerry Mc

-----Original Message-----
From: Alan Robinson [mailto:arobinson@eclipseengineers.net]
Sent: Tuesday, August 15, 2017 11:26 AM
To: McIntosh, Jerry - NRCS, Mayfield, KY <jerry.mcintosh@ky.usda.gov>

Section 10 – Evaluation of Recommended Facilities Plan

A. Purpose

The purpose of this chapter is to:

- Summarize improvements to be completed within 0-2 year time period for the collection system and wastewater treatment plant.
- Estimate additional user charges required for the 0-2 year for the collection system and wastewater treatment plant.
- Present a list of project activities and a proposed implementation schedule for the collection system and wastewater treatment plant.

B. Collection System Improvements

The selected alternative for the wastewater collection system improvements is the use of conventional design sewer system using dig and replace as well as slip-lining with CIPP. The improvements to the collection system will be implemented in the 0-2 year phase covering the seven areas as outlined in Chapter 7. The improvements will be within the existing service area with a goal of reducing I/I issues that have plagued the City for decades.

C. New WWTP

The selected alternative for the new wastewater treatment plant (WWTP) is construction of a new continuously sequencing reactor WWTP at a new site. When implemented, this will increase treatment capacity to 1.5 million gallons per day (MGD) and increase the peak hourly capacity to 6.0 MGD. Based on the city's Corrective Action Plan, all of the recommended improvements for the new wastewater treatment plant should be designed and constructed immediately. Implementation of the selected alternative will reserve adequate space for later expansion. There is no foreseeable need for expansion beyond 1.5 MGD, which is beyond the 20-year planning period of this study.

D. Implementation

Tables 10-1 and 10-2 summarize the Project cost for implementing the Marion wastewater system's recommended improvements for the 0-2 year planning phase

Table 10-1
0-2 Year Opinion of Collection System and WWTP Probable Project Cost

Item	Cost
WWTP Facilities[1]	$10,000,000
Collection System Improvements[2]	$2,000,000
Total Construction Cost	**$12,000,000**
Project Development	1,700,000
Total Opinion of Probable Project Cost	**$13,700,000**

Notes: [1]Alternative 3 – Continuously Sequencing Reactor at new site, see Table 8-6.
[2]Includes Areas 1 through 7, see Table 8-1

E. User Costs

Prior to a recent increase, the City of Marion's current user charges did not generate sufficient revenue to cover existing costs associated with the wastewater collection and treatment system. It was assumed for this report that all future costs will be covered by additional user charges for the proposed projects. The current user charges are summarized in Table 10-2.

Table 10-2
Current Sewer User Charges[1]

Water Consumption (total gallons per month)	User Fee	Environmental Fee[2]	Total Fee
Up to 1,500	$14.32	$8.00	$22.32[3]
2,000	16.96	12.00	28.96
3,000	22.24	12.00	34.24
4,000	27.52	12.00	39.52
5,000	32.80	12.00	44.80
6,000	37.02	16.00	53.02
7,000	41.24	16.00	57.24
8,000	45.46	16.00	61.46
9,000	49.68	16.00	65.68
10,000	53.90	16.00	69.90
15,000	75.00	16.00	91.00
20,000	92.60	55.00	147.60
25,000	110.20	55.00	165.20

Notes: [1]Per City of Marion User Fee Ordinance 2016
[2]Environmental Fee added to receive KIA P&D Loan, August 2016
[3]Minimum monthly charge for all water consumption up to 1,500 gallons.

Based on the 0-2 Year Opinion of Probable Project Cost (Table 10-1) for the total project, estimated user fee increases were calculated. These estimates assume use of a 30-year Kentucky Infrastructure Authority (KIA) loan (at an interest rate of 0.75 percent) as the primary funding source for the project. The projected user fee increases are presented in Table 10-3. Please note that based on actual funding obtained and construction bids received, a detailed user cost study will be necessary to determine the actual user costs.

Table 10-3
Preliminary User Fee Increases

Project Funding	**Project Cost, $**
WWTP Construction (including contingency)	10,000,000
Collection System Construction (including contingency)	+2,000,000
Total Construction	=12,000,000
Planning & Design plus other Development	+1,700,000
TOTAL PROJECT COST	=13,700,000
Local Monies	-0
CDBG Grant	-1,000,000
KIA Grant	-1,200,000
Total KIA Loan	=11,500,000
Annual Revenue Requirements	
KIA Debt Service[2]	429,000
KIA Service Charge[3]	23,000
Increased O,M&R[4]	10,000
Total Required Additional Annual Revenue	462,000
Monthly Increase per Thousand Gallon Usage[5]	5.24
Average Increase Based on 4,000 Gallons per Month Usage[6]	20.96
Existing user charge[7]	27.52
Existing environmental fee[7]	12.00
Projected user charge [7]	48.48
Projected environmental fee[7]	$0.00

Notes:
[1]Cost in thousands
[2]Based on Kentucky Infrastructure Authority (KIA) loan with an interest rate of 0.75% over a 30-year period (0.0373)
[3]The service charge is based on 0.2 percent of the outstanding loan amount annually.
[4]Added operation and maintenance (O&M) cost based on 0.82 million gallons per day average flow for new WWTP
[5]Based on 88,098,900 gallons of water usage per year (2014) per City of Marion
[6]Typical residential monthly water use
[7]Based on average monthly usage of 4,000 gallons

F. Environmental Benifits

Environmental benefits for this project include the following:

- Water quality improvement to Rush Creek and downstream habits as the City will eliminate approximately 70 million gallons of diluted raw sewage from bypassing the WWTP during moderate to severe storm events.
- Collection system exfiltration will likely be reduced in areas of the system.
- The WWTP will be removed from the 100-year flood plain which will eliminate untreated or partially treated sewage from entering the environment. Dried sludge will not be exposed to this floodplain as well.
- Archeological and historical environment has been reviewed and is not at risk from the construction of this project.

G. Funding Plan

As discussed in this Chapter, the City intends to pursue KIA Fund A Clean Water State Revolving Funds to fund the improvements discussed in this Facilities Plan. Planning and Design funds have already been allocated and this Marion project ranks very high in the KIA list of projects for funding.

Marion's median household income will also allow them to obtain the lowest possibly interest rate on all money borrowed. Forgiveness grants as well as CDBG and DRA grants will be pursued as well. Other loan programs will be investigated such as USDA Rural Development Loan/Grant but this program does not look as attractive as the KIA SRF program at this time.

H. Implementation Schedule

The following is a list of implementation steps recommended to cost-effectively proceed with the proposed wastewater system improvements.

- Submit Facilities Plan to Kentucky Division of Water (DOW) for review.
- Review Facilities Plan by City of Marion and Crittenden County.
- Conduct public hearing.
- Obtain DOW review comments.
- Respond to comments.
- Obtain approval of Facilities Plan from DOW.
- Submit loan and grant funding applications.

- Receive binding funding commitments from Kentucky Infrastructure Authority, CDBG, and/or other agencies.
- Complete preliminary design of wastewater system improvements.
- Prepare final design documents.
- Submit final plans and specifications to DOW.
- Respond to comments from DOW.
- Advertise project for competitive bids.
- Receive bids.
- Conduct final sewer user charge study.
- Award construction contracts and initiate project construction.
- Construction period.
- Perform start-up services and training.
- Prepare operation and maintenance manual and plan of operation.

Section 11 – Documentation of Public Participation

A. Purpose

The purpose of this chapter is to:

- Present the public hearing notification for the wastewater Facilities Plan.
- Provide a transcript of the hearing and a summary of written comments received from the public.

B. Public Hearing

The City of Marion (City) and Eclipse Engineers, PLLC, will conduct a public hearing to receive input from all interested parties. During the public hearing, the City of Marion and Eclipse Engineers, PLLC, will present an overview of the Facilities Plan, including a description of the findings and recommendations.

C. Written Comments

Written comments received will be included in *Appendix P.*

D. Ancillary Information

- Clearinghouse comments related to this project are included in *Appendix Q.*
- The Division of Water (DOW) Facilities Plan Preparation Checklist is included in *Appendix R* to assist DOW staff with the review and approval of this document.